Compressed Air Magazine

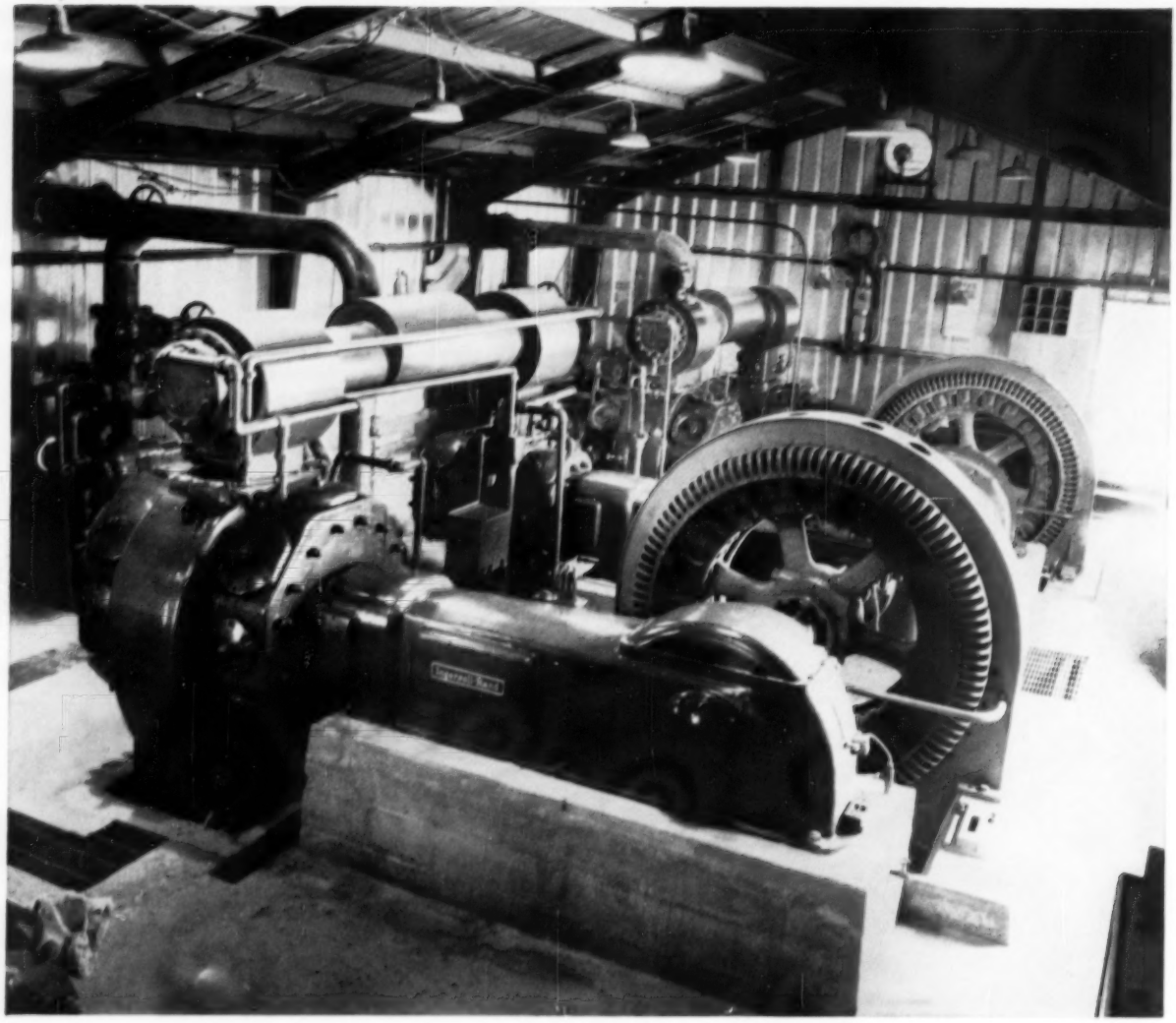
JUNE 1957

WIDE-AWAKE CAT CRACKER

Operations at Tidewater's Delaware Refinery run around the clock

(See Index Page and Page 168)

VOLUME 62 • NUMBER 6 NEW YORK • LONDON



Texaco helps ease compressor strain

Where compressors do a normal day's work, their load is likely to vary from one minute to the next. Even more so under severe conditions. That's why you need *specialized Texaco Regal Oil R & O.*

The essential thing about *Texaco Regal Oil R & O* is that it prevents rust and harmful deposits from clogging oil lines, valves and cylinders. It keeps intercoolers and aftercoolers rust*free*, and rod and bearing temperatures normal.

There is a complete line of *Texaco Regal Oils R & O* to provide more efficient operation with lower maintenance costs. Ask any Texaco Lubrication Engineer to help you select the right ones. Call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States—or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

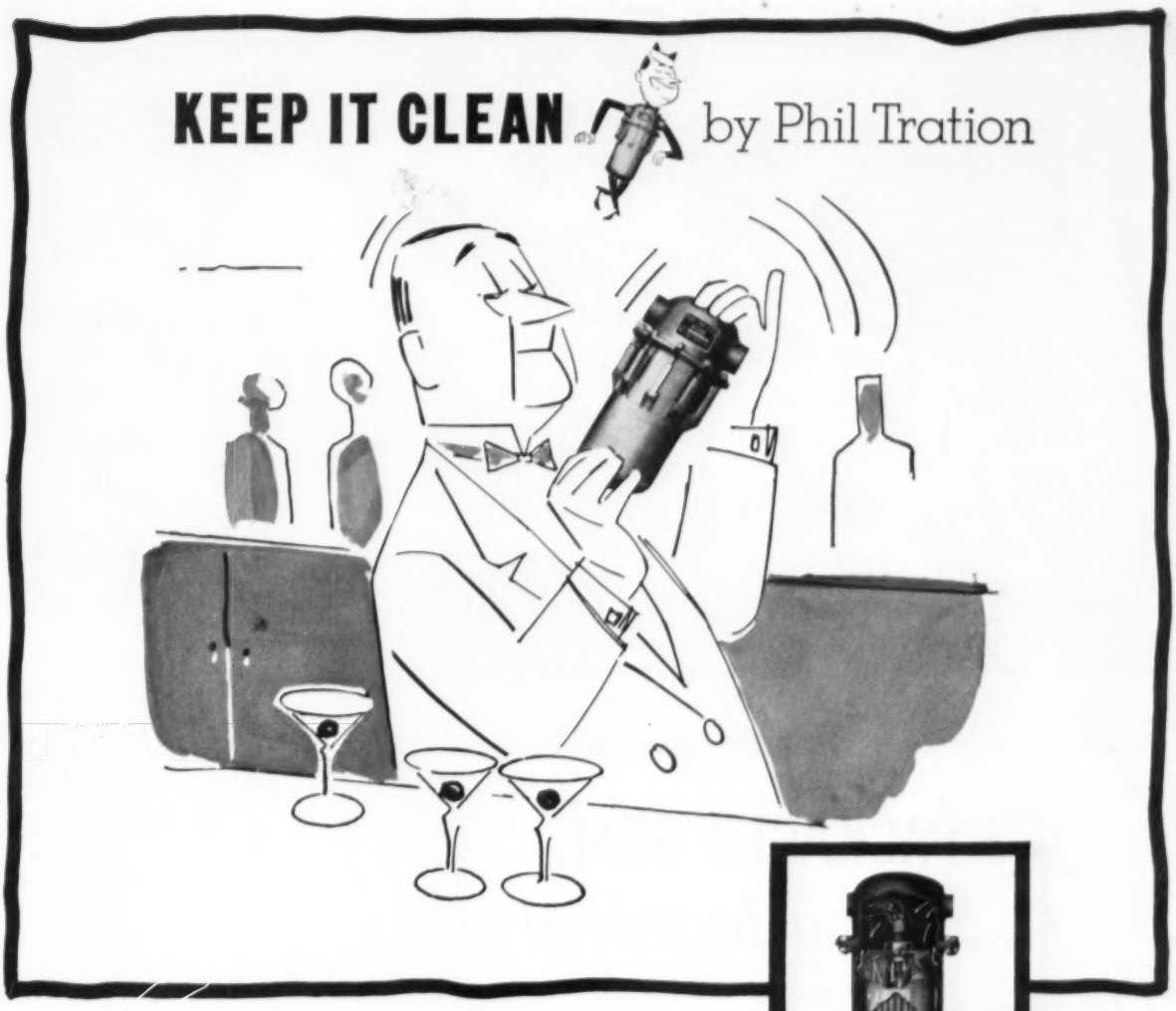
TEXACO

TEXACO Regal Oils R & O

FOR ALL AIR COMPRESSORS AND OPERATING CONDITIONS

Circle 1A on reply card

KEEP IT CLEAN by Phil Tration



An inscrutable Bar-keep named Hugh
made martinis in Filters, "Staynew."
The results were uncouth—all gin, no vermouth
But, oh how his clientele grew!

Howsomever, the uses for Dollinger Filters do seem unlimited. Every day some bright engineer figures out a new way to save his company money just by installing the right filter, at the right place in a liquid, gas, or air line. (Be surprised what that does for the engineer's reputation too.)

If you have an idea for saving money with filters, and you'd like to talk with someone about it . . . may we suggest you contact someone with a *complete* line, someone with a little "know-how," someone with a reputation for quality . . . someone like your Dollinger sales engineer.

STAYNEW MODEL CPH PIPE LINE FILTER has the exclusive "double action principle." Air is first deflected to outer walls of Filters and forced downward at high speed. Water, oil, and heavier particles of rust, etc. are thus deposited in base. Mechanically cleaned air then rises to pass through filtering medium which removes lighter airborne particles. This "double action" design eliminates need for frequent cleaning.

Inexpensive, simple to install, Dollinger Pipe Line Filters pay for themselves in reduced maintenance alone. Why not talk over your filtration problems with a Dollinger engineer . . . or write for Bulletin 200 which gives engineering data on pipe line filters. Dollinger Corporation, 7 Centre Park, Rochester 3, N.Y.

MR PROTECTOMOTOR U.S. PAT. OFF.

STAYNEW **DOLLINGER**

FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

Circle 2A on reply card

THE PACKAGED SEAL
of a hundred uses

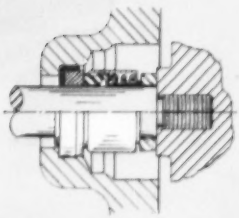
This Garlock MECHANIPAK* Seal BB-21A has proved itself on hundreds of jobs, sealing against water, oils, alcohol, mild acids, and solvents. It's ideal for shafts on centrifugal pumps, automatic washers, speed reducers, commercial dishwashers . . . wherever pressures do not exceed 150 psi.

Withstands temperatures to 212° F. with standard bellows or up to 400° F. with silicone rubber bellows . . . shaft speeds to 2000 fpm and higher depending on operating conditions. Sizes for 3/8" to 3" dia. shafts. Mechanical drive arrangement is engineered to eliminate slippage and simplify installation.

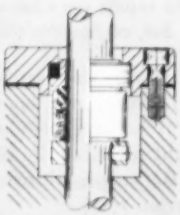
The BB-21A is another important part of "the Garlock 2,000"... two thousand different styles of packings, gaskets, and seals to meet all your needs. The only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him today or write for Catalog AD-150.

*Registered Trademark

TYPICAL INSTALLATIONS



Centrifugal pump installation where stationary seat fits in housing and impeller provides stop for seal. A cup type vibration ring holds stationary seat. (Vibration ring design optional.)



Vertical shaft installation where lock-nut positions seal on shaft and stationary seat is in gland. A square vibration ring is used to hold stationary seat. (Vibration ring design optional.)

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For prompt service, *contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.*

GARLOCK

Packings, Gaskets, Oil Seals,
Mechanical Seals,
Rubber Expansion Joints,
Fluorocarbon Products

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Save With Eimcos

In a wide variety of mining systems, where profit depends on high tonnage, low cost mucking... there are IMPORTANT REASONS why Eimco 630's get the job done better!

The 630 has a 6,000 lb. digging force behind its ½ cu. yd. bucket for fast digging. Overhead discharge eliminates time-killing turns and maneuvers. With experienced operator and good car availability, it is not unusual to expect production up to 4 tons per minute.

With his left hand the operator controls independent track movement... with his right, bucket motion. He can crowd the pile from any angle and manipulate the bucket simultaneously. He can twist, turn, get out of tight places at full speed under full load. Moveing the 630 from place to place is easy and fast.

Rugged construction and exclusive protective features insure against costly mechanical delays.

These among other factors make the Eimco 630 Excavator your best investment per cubic yard capacity. Write for full details or arrange to have an Eimco engineer visit you!

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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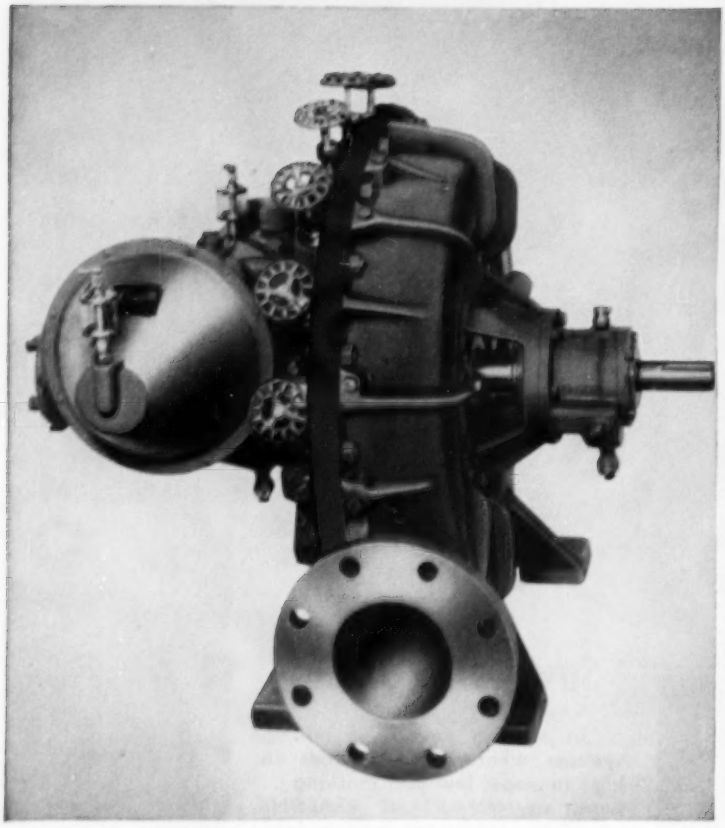
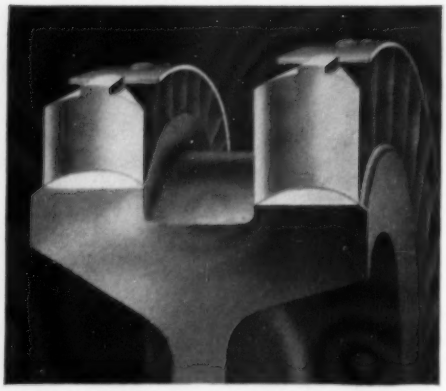
EIMCO

B-261



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

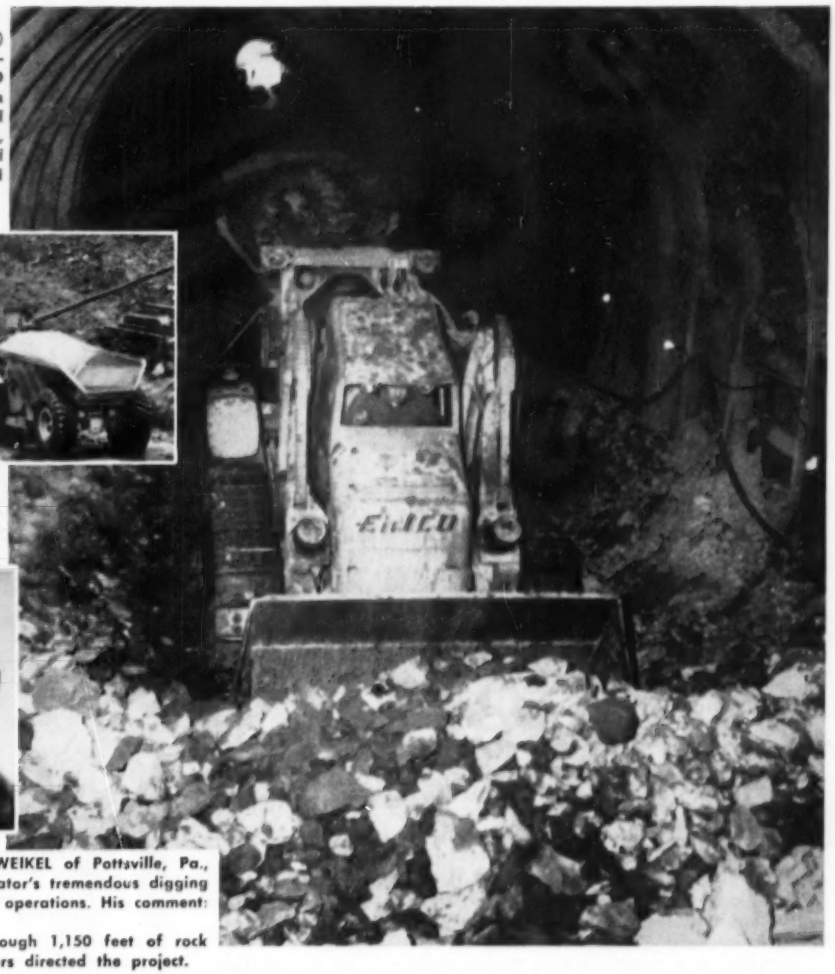
COPPUS ENGINEERING CORPORATION
206 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Quoting H.E. (ACE) GREEN, tunnel superintendent: "EIMCO 105 Excavators with heft to dig fast and overhead discharge, are the fastest tunnel loaders I've worked with."

The project was organized on a two cycle, 24 hour timetable with two drill and two mucking shifts. Here, Eimco 105 and dump wagons wait out blasting operations.

Quoting J. E. R. WOOD, president, NORTHWOOD INC.: "The fact that we have four EIMCO 105's is proof we're sure they promote high tonnage production."



WILKES-BARRE, PA. - Operator JOSEPH WEIKEL of Pottsville, Pa., prepares to unleash the EIMCO 105 Excavator's tremendous digging power during Bear Creek Diversion Tunnel operations. His comment: "It's the digginest machine I've operated."

The 19' circular bore was blasted through 1,150 feet of rock by NORTHWOOD INC. U.S. Army engineers directed the project.

EIMCO 105 SAVES TIME MUCKING FOR TUNNEL DRIVERS

"SAVES MINUTES EVERY CYCLE." That's how AL AITKEN, V-P, NORTHWOOD INC., supervisor of Bear Creek Tunnel operations, describes the EIMCO 105 Excavator's performance.

Part of the $18 million Bear Creek Reservoir Project, this tunnel will be outlet channel for the 234' high earthen dam. NORTHWOOD, with main offices in Vancouver B.C., is one of the Continent's active tunnel drivers.

Equipped with 1½ yard excavating bucket, the EIMCO 105 loaded 100 cubic yards of material into dump wagons after each blast. Between 200 and 400 lbs. of dynamite, used in a 48-hole drilling and shooting pattern (usually fired in 10 stages of delay) produced an average advance of 7½' per round . . . 15' per day.

The tunnel was drilled to a bore size of 19' in the rough using 6 jack legs on a single deck jumbo. Concrete lining will reduce inside diameter to 16'. Six inch I-beam supports wedged tightly with wooden blocking are spaced every 4'. The EIMCO 105 now is taking up a 4' bottom left to provide flat surface for trucks.

NORTHWOOD'S high appraisal of the EIMCO 105 is duplicated often in field reports from tunnel projects and mines throughout the world.

With any attachment--Excavator, Front-End Loader, Bulldozer, Fork Lift, and others--EIMCO 105 owners get superior design . . performance speed and power . . . operating ease and economy . . . versatile maneuverability . . . dependable service under hard usage.

Plan now to learn why you can shade your next bid and still keep the profit by figuring earthmoving costs around the EIMCO 105.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Pittsburgh, Pa. Seattle, Wash. Cleveland, Ohio Houston, Tex. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B 265

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Fast...

Positive!

Quarter-Turn Control

for Compressed Air Lines

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Simple operating principle A double-acting cam lowers the valve stem smoothly and with relatively little effort for fast, positive closure. Raising the stem to open the valve, in the 2-inch size, is accomplished by this same cam. In all the smaller sizes, return spring action replaces cam action in opening the valves.

Eliminates Compressed Air Leaks Designed specifically for compressed air lines, the Grinnell-Saunders Diaphragm Valves give positive leakproof closure. A flexible diaphragm, seating on metal, assures this perfect seal. At the same time, because working parts are wholly isolated, no packing glands are necessary, and stem leaks are impossible.

Variety of Applications In the smaller sizes, the quarter-turn, lever-operated Grinnell-Saunders Diaphragm Valve is ideal for air-operated tools, presses, clamps, molds, or wherever fast control is requisite. In the larger sizes, it supplies quick control of air agitators, or large headers at compressors where speed may be a safety factor.

Lower Maintenance is a further big advantage you get with Grinnell-Saunders Valves. No refacing or reseating is required. No packing glands to demand attention. And diaphragm replacement can be made simply, without removing valve body from the line.

For further details, write for Grinnell-Saunders Diaphragm Valve Catalog.

SIZES: ½ to 2-inch

CHOICE OF MATERIALS

Bodies — iron; cast steel; stainless steel; Durimet 20; Hastelloy A, B, C; bronze; Monel; aluminum; PVC (polyvinyl chloride); Saran

Body linings — hard rubber; soft rubber; neoprene; glass; lead; plastics; Heresite; Lithcote

Diaphragms — soft natural rubber; natural rubber; white synthetic rubber; neoprene; reinforced neoprene; butyl; Hycar; Teflon; Kel-F; PVC (polyvinyl chloride); polyethylene

Bonnets — iron; stainless steel; bronze; other materials on special order

CHOICE OF BODIES

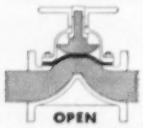
Straight bodies — screwed; flanged; socket weld; butt weld; socket (solder); sanitary threads; hose ends; Victaulic

Angle bodies — screwed; flanged; socket weld

OTHER BONNETS: ¼ to 18-inch

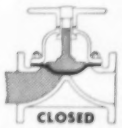
Handwheel (non-indicating stem, indicating stem) ¼ to 18-inch; sliding stem (for a wide selection of power operated topworks), ½ to 12-inch.

SIMPLICITY OF OPERATION



OPEN

Diaphragm lifts high for streamline flow in either direction



CLOSED

Diaphragm presses tightly against the valve weir for air-tight closure

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

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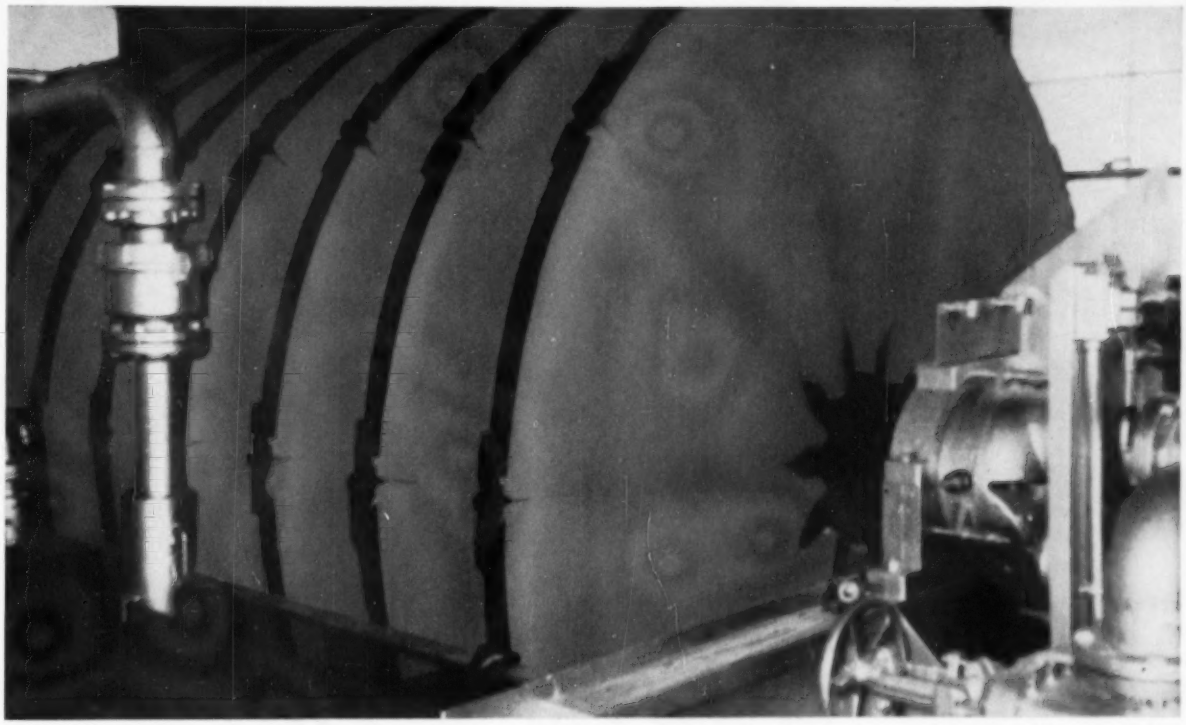


NEW GILSONITE PROCESS EMPLOYS EIMCO AGIDISC FILTER

A transport system unique to the Gilsonite Industry was introduced recently when Gilsonite began flowing over mountainous terrain thru a 6" pipeline . . running 72 miles from **American Gilsonite's** Bonanza, Utah mine to a high process distillation plant at Gilsonite, Colo.

The mineral is crushed, suspended in water and pumped thru the line at a rate approximating 3 mph. Concentrate is fed into the station thru an 8' 10" x 10 disc **Eimco Agidisc Filter** . . the **only** filter employed in a separation process involving a Gilsonite slurry.

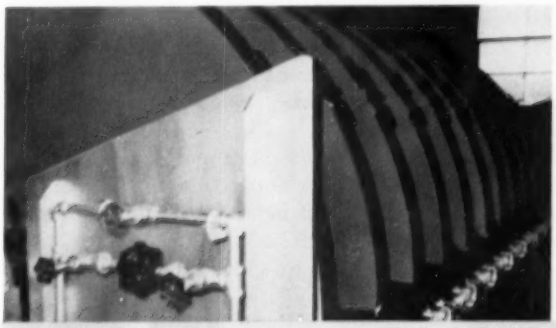
American Gilsonite, after years of research, decided this was a feasible transport method. It is anticipated that the line will deliver 260,000 tons of Gilsonite each year.

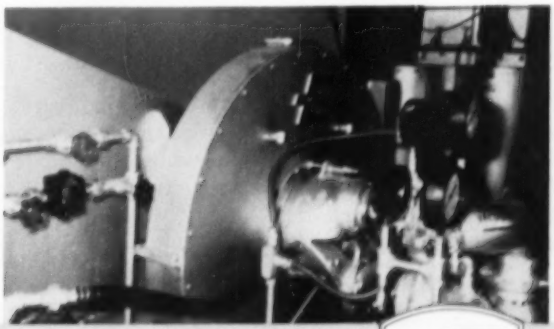
The **Eimco Agidisc** is regulative equipment for the plant, controlled entirely by automation. Methods employed will produce carbons extremely high in quality.

Teamwork between engineering personnel at **American Gilsonite** and **Eimco** resulted in the elaborate, highly practical piping system seen in the photos. **Eimco Hy-Flow Design** (lower right) is provided throughout the filter to permit "straight-through" flow of filtrate and air. Filtrate load is divided between two valves (one at each end of the center barrel) to further increase capacity.

These features, plus properly directed agitation and rugged steel construction, promote high velocity . . uniform particle suspension and cake formation . . low cake moisture content . . excellent filtrate clarity . . long, trouble free service.

Write today for full information on the Eimco Agidisc Filter.





THE EIMCO CORPORATION

SALT LAKE CITY, UTAH

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B-263

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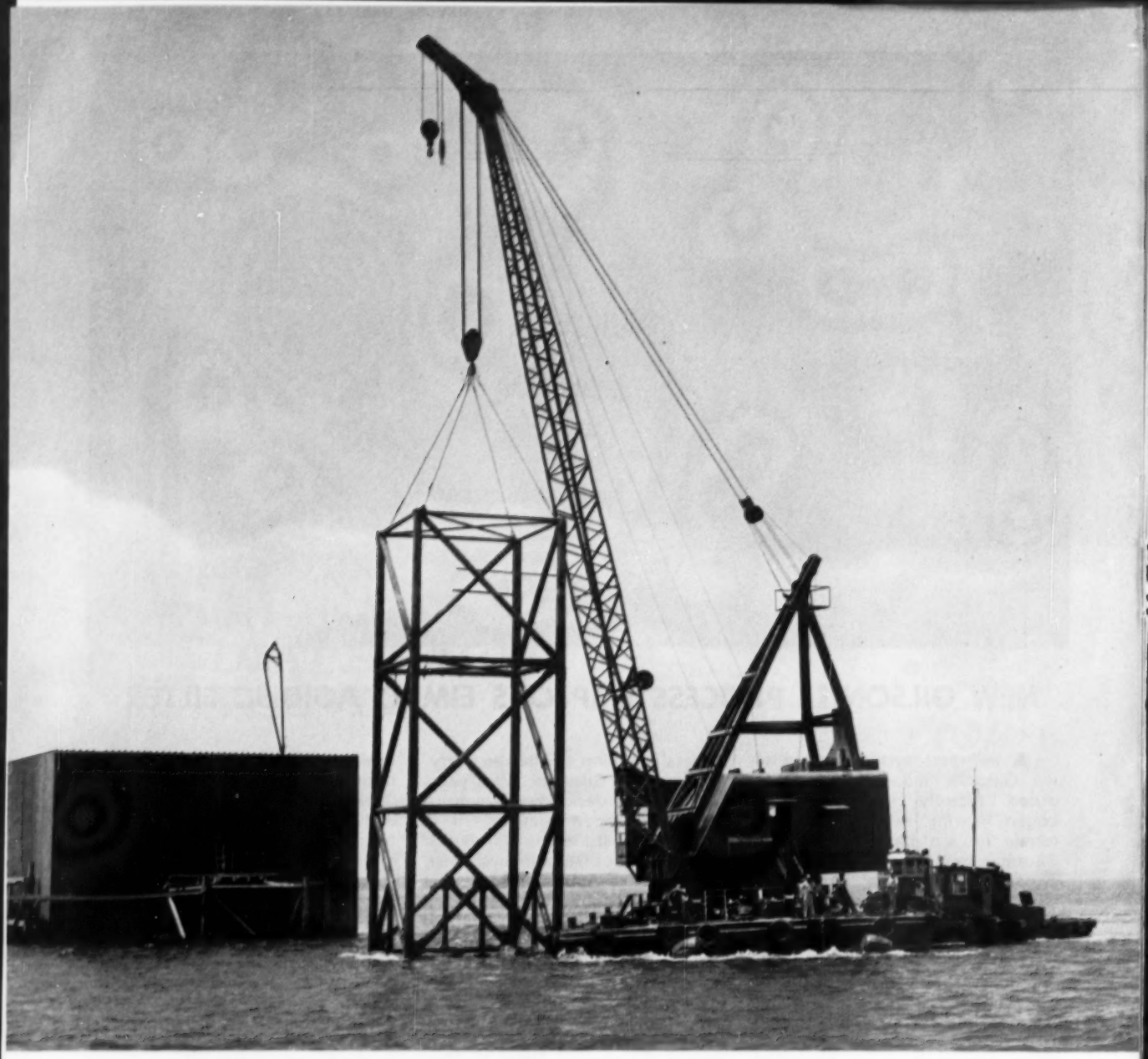


WIRE ROPE AT WORK

A great bridge is not erected overnight, and months of dogged effort are required before the span begins to take shape. Here's a scene that was common during the early work on the Rappahannock River Bridge—a $15,000,000 project in eastern Virginia. When completed, the bridge will link White Stone and Greys Point, thereby crossing the river at one of its broadest parts.

The photograph shows equipment of the Diamond Construction Company positioning a guide tower. The crane was rigged with Bethlehem wire rope, 1-in. Purple Strand. Bethlehem rope was also used for handling caisson domes, and for excavating through the caisson wells. Almost anywhere you looked, in fact, some of this tough steel cable could be seen in action, lifting, lowering, or pulling heavy loads.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

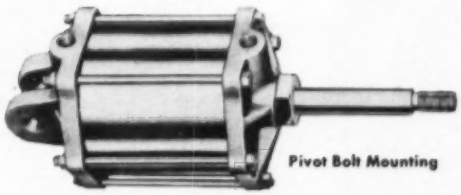
Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

CONSTRUCTION • EXCAVATING • MINING • QUARRYING • PETROLEUM • LOGGING • MANUFACTURING

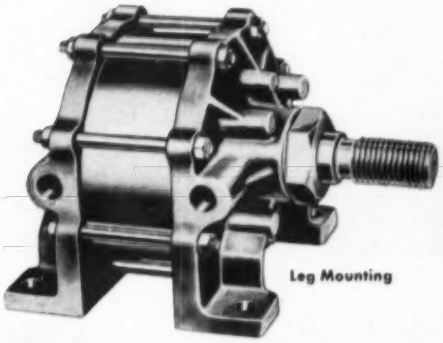
Schrader®...

your one source for AIR CYLINDERS

push, pull, single or double-acting, with or without cushion
. . . for every type and mounting

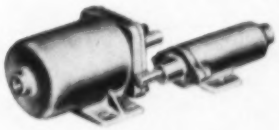


Pivot Bolt Mounting

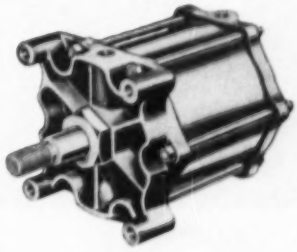


Leg Mounting

Base Mounting

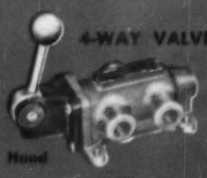


Small
Clamping Cylinders



Flush Mounting

VALVES and everything you need in AIR ACCESSORIES



4-WAY VALVES

Hand

Foot

Pilot, Solenoid, Treadle and others

2- AND 3-WAY VALVES

All types: Roller, Cam, Hand, Foot, etc.

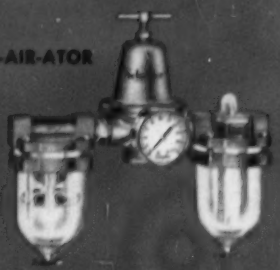
Flow Control Valves

Quick Exhaust Valves

Couplers and Hose Fittings

Ferrules and Tools

Air Hose
Various Diameters



LUB-AIR-ATOR

Filter • Regulator • Lubricator
Available separately or in combination

Schrader®
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Available for immediate delivery from your Schrader Distributor

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QUALITY AIR CONTROL PRODUCTS

CAN'T LIVE WITHOUT IT

How to Get Vital Air Into Underground Diggings . . . . . Faster and at Lower Cost

Men can't work underground without plenty of fresh air—and there's no better way to supply it than through dependable, economical Naylor Spiralweld pipe.

Here's the one lightweight pipe with the exclusive spiral-lock structure that provides the extra collapse strength required for push-pull ventilation. It's faster and easier to install in tunnel work—especially when joined with the one-piece Naylor Wedgelock coupling. Since the diameter of this coupling is only slightly greater than the diameter of the pipe, lines hug the wall and can be made up with only one side of the pipe in the open. Also, lines can be extended quickly as work progresses.

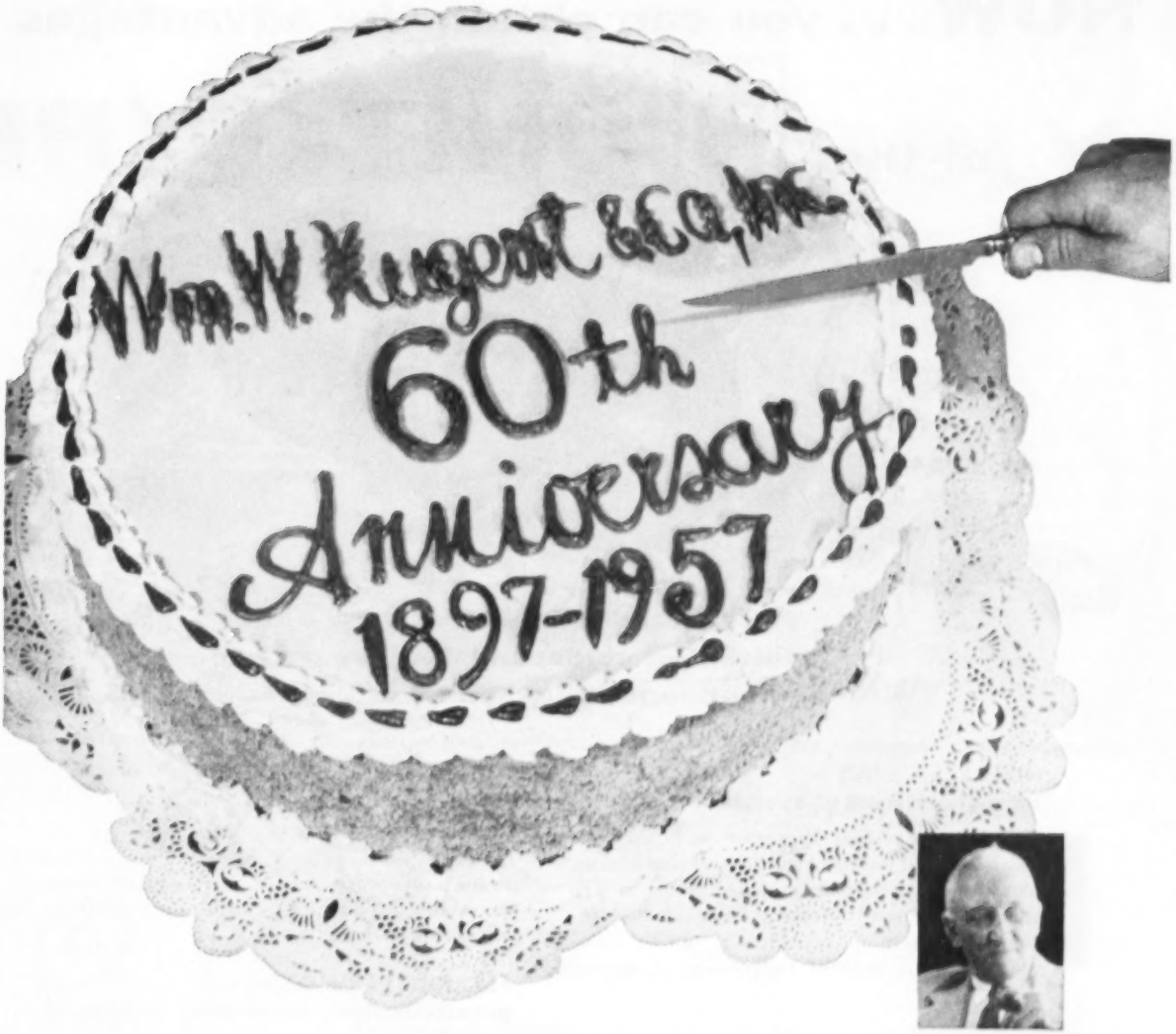
But savings in time are only part of the Naylor economy story. The extra strength of the Naylor structure permits the use of lighter gauge material at lower cost, without sacrifice of performance. The larger the diameter, the more this is true.

For full details, write for Bulletins No. 507 and No. 514.

NAYLOR

NAYLOR PIPE COMPANY
1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office:
60 East 42nd Street, New York 17, N. Y.



WM. W. NUGENT
Founder

CORLISS D. NUGENT
President

WM. WARREN NUGENT
Secretary

Before we cut the cake...

Wm. W. Nugent & Co., Inc., on the occasion of its sixtieth anniversary, wishes to express its sincere appreciation for the confidence and loyalty toward Nugent products, demonstrated by an ever increasing acceptance throughout industry.

For three generations, Nugent products have embodied only highest quality design, materials and workmanship. The future shall find no compromise with that policy.

Established 1897

Wm. W. Nugent & Co., Inc.

3434 Cleveland Street Skokie, Illinois

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

Representatives in Boston • Cincinnati • Detroit • Houston • Los Angeles • Minneapolis • New Orleans • New York • Philadelphia • Portland, Oregon • San Francisco • Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

NOW... you can obtain the advantages of the I-R UNIT-TYPE

Here's how the I-R Unit-Type rotor design contributes to dependable pump performance with minimum operating and maintenance expense.

HIGH EFFICIENCY— throughout years of operation

The simplicity of Unit-Type rotor design with precision-matched impellers and channel ring sections plus simple, direct fluid passages results in high operating efficiency. Efficiency stays high, too, because clearances are realistic and can be maintained without frequent replacement of wearing parts.

EASIER MAINTENANCE— and less of it

The Unit-Type rotor permits quick and easy removal of the entire rotor assembly without disturbing suction and discharge connections. All parts of the assembly are readily accessible, and easy to remove and reassemble. There are no shrink fits or delicate alignment problems.

GREATER INTERCHANGEABILITY— smaller spare parts inventory

Maximum interchangeability of rotor-assembly parts makes it unnecessary to stock separate replacement units for each individual stage. Except for the suction and discharge stages, impellers and channel rings are completely interchangeable.

SYMMETRICAL CASING— for greater strength

Unit-Type rotor assembly eliminates intricate hydraulic passages in the casing. The symmetrical casing provides greater strength, minimizes thermal distortion, and permits an attractive, streamlined exterior appearance.

FLEXIBILITY OF DESIGN— permits changes in operating conditions

Changes in operating conditions can be met easily by installing a new combination of impellers and channel rings on the original shaft...in the original casing. Forseeable changes in operating conditions can also be met by using "dummy" stages which can later be replaced by complete working assemblies. Unit-Type rotor design and smooth bore casing makes this possible.

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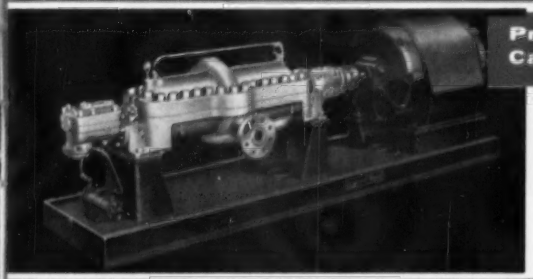
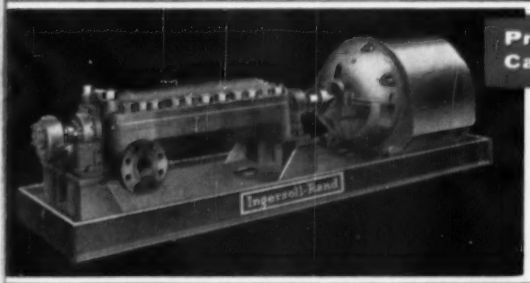


Pressures: 300 to 1000 psi
Capacities: to 700 gpm

Class CNTA

Recommended for medium pressure installations, the Ingersoll-Rand Class CNTA is today's most modern and efficient multi-stage boiler-feed pump in its pressure class.

It has a smooth-bore, symmetrical casing and features opposed impeller groups to neutralize axial thrust. Bearings can be either sleeve- or ball-type.



Pressures: to 1200 psi
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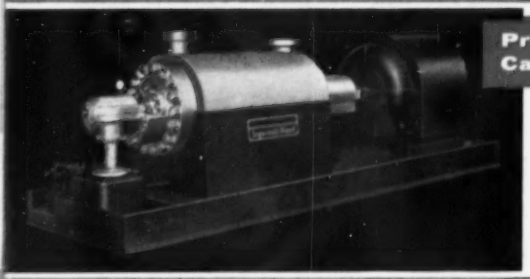
Class HMTA and HMTB

I-R Class HMTA and HMTB multi-stage centrifugal pumps feature a symmetrical, horizontally-split casing and "in-line" staging.

Supplied in from 3 to 9 stages, they are widely installed as boiler-feed pumps in central stations and industrial plants. Ball- or sleeve-type bearings are available.



Pressures: to 6500 psi
Capacities: to 2800 gpm

Class CHTA and CHTB

Of the double-case design, Class CHTA and CHTB multi-stage centrifugals consist of a vertically-split inner assembly enclosed in a heavy cylindrical outer casing.

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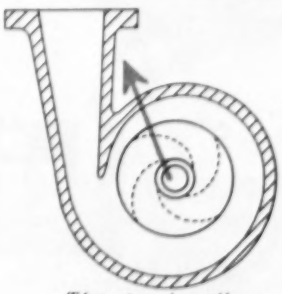
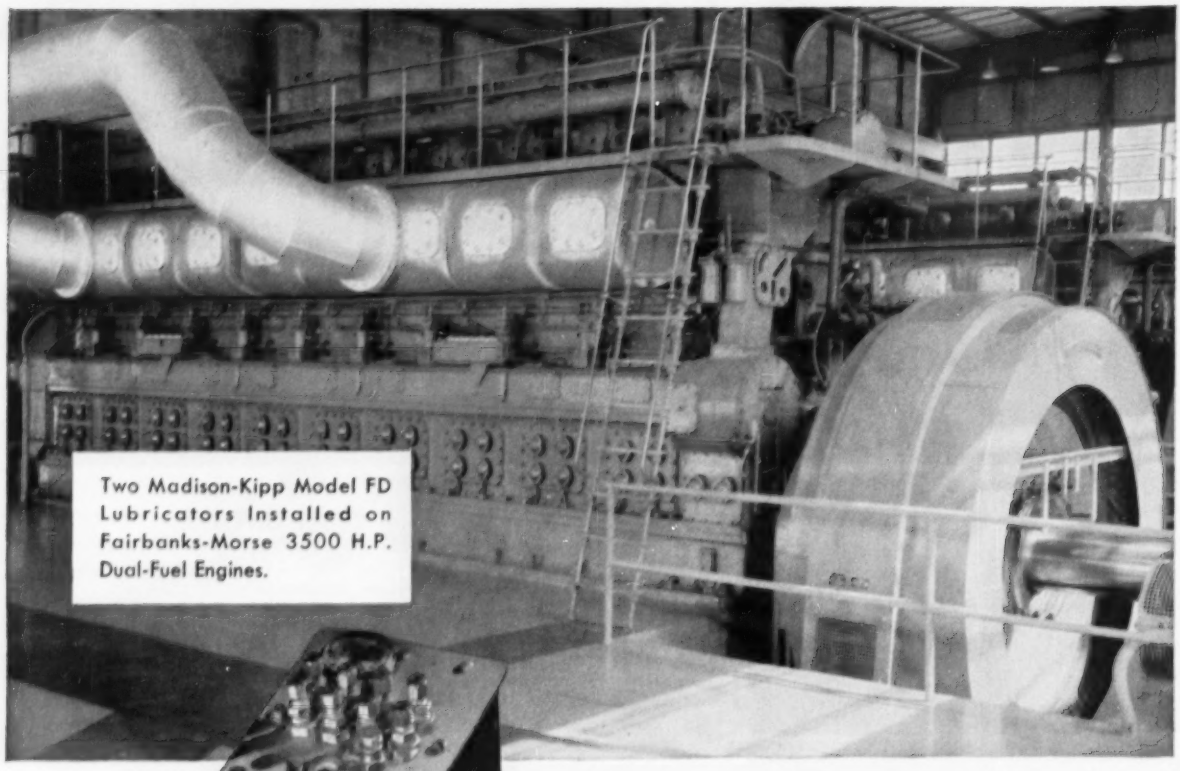
COMPLETE RADIAL BALANCE—a feature of all these I-R boiler-feed pumps

Evenly spaced volute passages around the entire circumference of the impeller balance the radial thrust force. That is, the radial forces become equal in all directions with a zero resultant on the impeller.

With a single volute casing, a radial thrust force is created due to the uneven pressure distribution around the periphery of the impeller. This force tends to deflect the shaft and cause the rings to rub with a loss in efficiency.



Thrust on impeller unbalanced in single volute design



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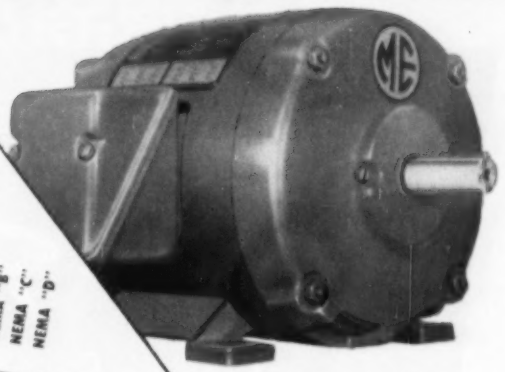

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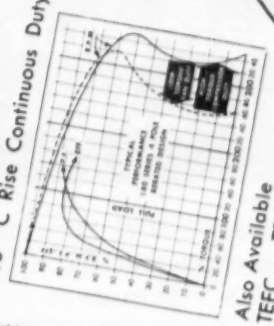

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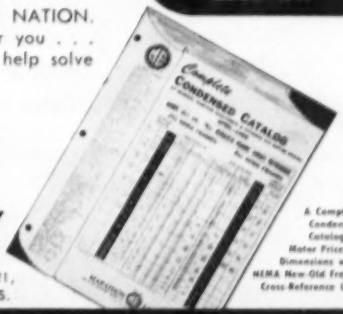

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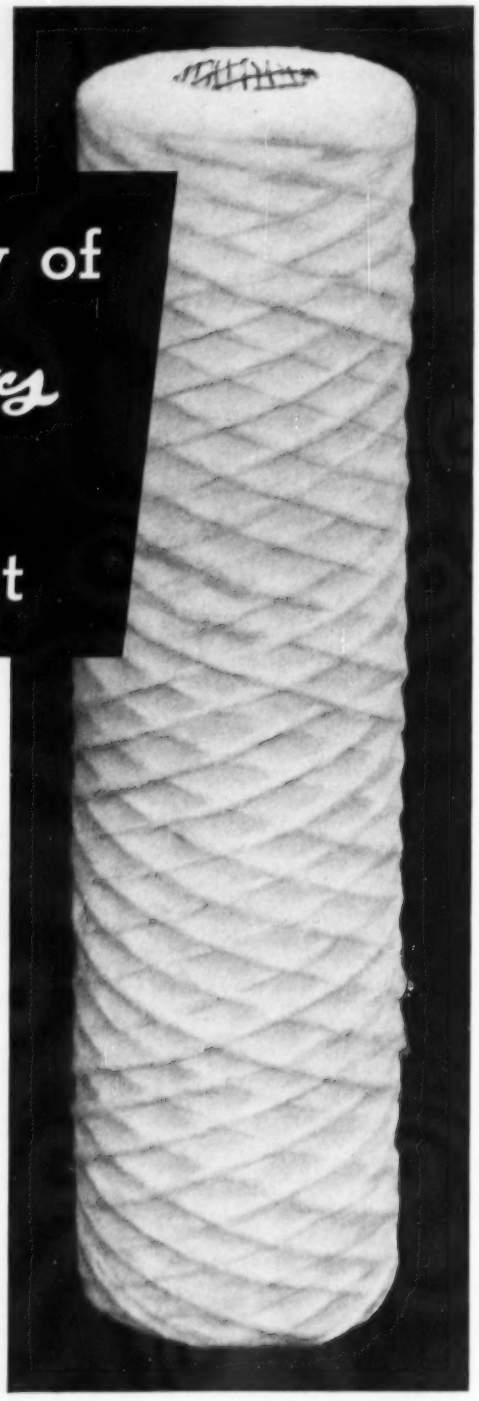

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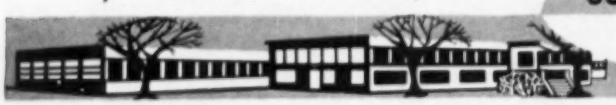

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ON THE COVER

WHEN a refinery goes on stream, its operations never cease until some far-future date when units are shut down for overhaul. The brilliantly illuminated scene on the cover is a night view of the world's largest catalytic cracker. Now running 7 days a week, 24 hours a day, at Tidewater Oil Company's Delaware Refinery, the unit handles 102,000 barrels per day.

•

IN THIS ISSUE

JUST a year ago construction details involved in putting up the largest refinery ever built at one time were covered in this magazine. At that time 7000 men were swarming over a 450-acre tract, erecting vast converters, huge towers and giant compressors. On May 23, the result of their efforts was formally dedicated by Tidewater Oil Company. Our first article, page 162, is a pictorial tour of its facilities. Another article, to appear next month, will cover the Delaware Power & Light Company's Delaware City Station, erected to supply the refinery with power, process steam and water.

•

ONE of the reasons for this country's great industrial attainments is the high productive capacity of its basic iron and steel industry. A method of pushing it even higher by increasing blast furnace production is to add oxygen to the blast air. One of the first such operations in this country is described in the article beginning on page 170.

•

ANNUALLY, 73 million board feet of lumber are harvested from the hinterlands of Utah. The U. S. Forest Service, which is encouraging the cut, says that planned harvesting is the best insurance of future tree supplies. Compressed air plays an important part in the production of finished lumber. Page 175.

Compressed Air Magazine

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Delaware Refinery Goes On Stream

New Tidewater Oil Company 130,000-Barrel-Per-Day Refinery Dedicated May 23

R. J. NEMMERS

DELAWARE REFINERY—BEFORE AND AFTER

The picture above shows the major portion of the 5000-acre site owned by Tidewater Oil Company. Located about 15 miles south of Wilmington, Del., north of Delaware City, about 3500 acres of the land is now being farmed. In the background is the broad Delaware River where tankers supplying the new plant will dock. The other picture (right) taken less than 2 years later—and from the river side—shows the transformation of a 450-acre process-area plot, 1½-miles inland, into the largest refinery ever built at one time. In the foreground is the crude-intermediate- and finished-product storage-tank area. The tanks, having a capacity of 7,000,000 barrels, were fabricated and erected on a subcontract held by Chicago Bridge & Iron Company. In the right foreground is the Delaware Power & Light Company's Delaware City Power Station, built specifically to supply electricity and steam to the refinery. The power station will burn fluid coke and refinery gases.

SLIGHTLY more than 2 years ago, construction gangs moved onto a 5000-acre tract of farmland in Delaware and began the monumental task of erecting the largest refinery ever put up at one time. On May 23, the job not only was completed but the plant was in operation for the company's formal dedication. In the interim, an estimated 10,000 freight-car- and 70,000 truckloads of machinery, construction materials, pipe and other supplies converged on the site and the end result was a 130,000 barrel-per-day petroleum processing facility that in many ways defies description. The construction of the vast refinery was covered in COMPRESSED AIR MAGAZINE, June 1956. C. F. Braun & Company, Alhambra, Calif., built the plant on a turnkey contract—one calling for the design and construction of an operating facility to be turned over to Tidewater on completion. Of the principal units and general facilities in the refinery, nine licensed processes are included, four of them designed by the licensors. Design of the rest, as well as all procurement and construction, was by Braun.

The Delaware Refinery is gigantic. The tract of land on which it is located is reputedly the largest industrial site ever acquired at one time on the eastern seaboard. The plot adjoins the Delaware River, the main process area being about 1½ miles inland and occupying approximately 450 acres. It is surrounded by about 3500 acres that have been leased to Seabrook Farms, a major processor of frozen foods that already has gleaned several harvests from the rich soil. The remainder of the ground is taken up by a Delaware Power & Light Company-owned-and-operated 50,000-kw power plant, water-treatment facilities, a 275,000-gpm water-pumping plant and a good sized seaport for loading and unloading tankers.

The refinery equipment also is mammoth. Six of the eleven major process units are the world's largest: the biggest centrifugal blower ever built serves the largest fluid catalytic cracker ever designed; and the crude distillation unit, the catalytic reformer, the Udex extraction unit and the hydrodesulphurization plant are each the largest of their type yet built. The fluid coker is equalled in size only by one at Tidewater's west coast refinery.

The Delaware Refinery can be called unique; it is designed to handle any or all kinds of crude stocks and upgrade the entire crude feed. No Number 6 fuel oils—the bunker C or very low-grade variety that often sells for less than the cost of crude—need be produced. The end products of the new plant are Flying A Gasolines, jet fuel, aviation gasoline of the highest octane rating, higher grades of fuel and heating oils, liquefied petroleum gas (LPG), fluid coke and a variety of lesser, but

DELIVERY OF CRUDE

More than 200,000 barrels of South Louisiana crude, the first crude ever unloaded in the State of Delaware, was delivered to the Delaware Refinery last August 10 (left). The delivery, appropriately enough, was made by the S. S. "Flying A Delaware." The 628-foot, 27,000-ton supertanker is one of fifteen company-owned ships in service at the close of 1956. Seven others were under charter to bring the total tonnage to 506,677. In addition, nineteen other tankers will be added to the fleet by the end of 1963, thus adding another 1,054,000 tons to the Flying A fleet. The "Flying A Delaware" was unloaded at the rate of about 1,000,000 gallons per hour. Three T-head concrete piers at Delaware Refinery extend for 3000 feet along the river bank and can dock the world's largest tankers. They were designed and constructed by Frederick Snare Corporation. A large turning basin, connected to the river's main channel by a 400-foot-wide, 40-foot-deep, 2-mile-long channel, was dredged out by American Dredging Company. A 35-foot-wide pipeway extends from the port to the main process and storage area 1½ miles inland. There are more than 25 miles of pipe in the network disposed in sixteen different lines ranging from 4 to 30 inches in diameter. Finished products flow back to the dock through the same pipeway, as do compressed air, water and steam to service the dock area.

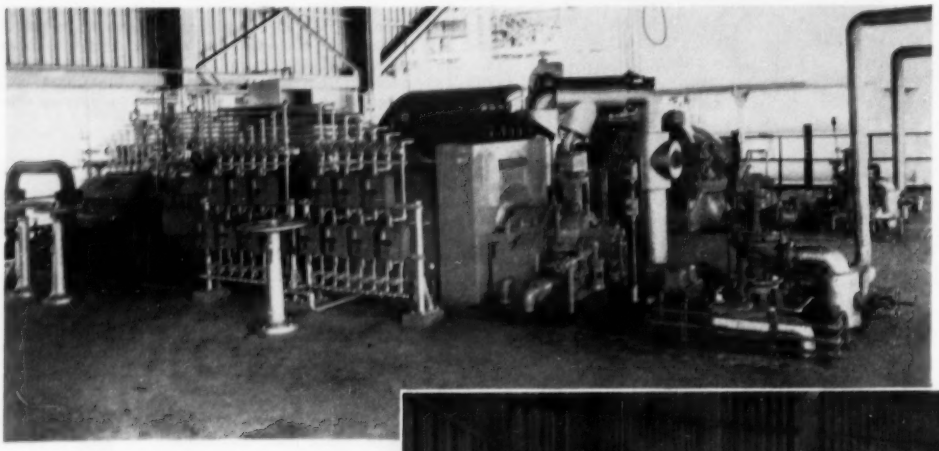
important, petro-products. For so large an integrated plant, the refinery has a great deal of flexibility; within certain limits the end products can be easily varied to meet changing market conditions, regardless of the feed stock.

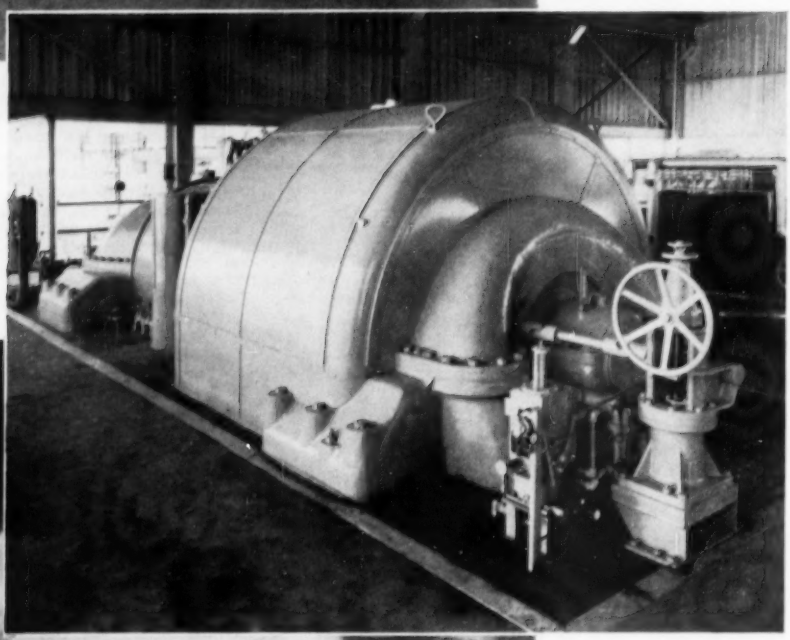
Compressors and pumps are the backbone of the Delaware Refinery. By the time a barrel of oil has been processed and shipped, it will have traveled about 250 miles either as gas or liquid through the maze of piping tying together the vast plant. The photographs reproduced on the following pages picture the refinery and the compressor equipment. Their captions tell the intricate story of the refining of crude oil.

CRUDE UNIT

The picture below shows the main features of the world's largest crude distillation unit. Gulping 130,000 barrels-per-day of crudes from all over the world, the crude unit, including treating facilities, has 11 steel columns, 25 pressure vessels, 66 heat exchangers and 2 fired vessels or stock heaters. Crude is heated first of all, then is passed through the two fractionating towers (center and left foreground) and separated into streams of raw gasoline, naphtha, kerosene, gas-oils, and heating and fuel oils. The stack towers 350 feet above the maze of piping making up the rest of the unit. The crude unit was completed and put into operation last September and its output, with the exception of marketable fuel oil, was stored until other units were completed.

One of the most important units at the Delaware Refinery in that it will upgrade less valuable and desirable refinery fuel oil into gasoline and heating oils, is the fluid coker. Having a daily capacity of 42,000 barrels, the unit is equaled in size only by another Tidewater coker—a sister plant at Tidewater's Avon (Calif.) Refinery that was completed last August. The Delaware coker is charged with the heavy bottoms or residue from the crude unit and produces a cat-cracker charge stock (the main product) as well as light coker gasoline. The product for which it is named, solid petroleum fluid coke, is actually a by-product of the process. About 1200 tons per day are turned out, the bulk of which is burned in the D P & L power plant. The name "fluid coke" was given to the solid granular product because it has many of the properties of fluids when aerated with compressed air. In other words, it can be piped and handled much the same as can a fluid. It is extremely hard, consisting of almost pure carbon and has a high heat value—14,300 Btus per pound—with a low percentage of volatile material. The picture at the lower left is an over-all view of the coker, the two large columns being the conversion towers. The taller of the two rises 250 feet above the ground. At the right, below, is an Ingersoll-Rand MTA 3112 turbo-compressor supplying 109,000 cfm of combustion air to the coker. The unit takes suction at 14.4 psia, discharges at 29.0 psia and is driven by an I-R 7200-hp turbine supplied with steam at 575-psig pressure and 750°F total temperature. The top view shows one of two 4300-hp centrifugal compressors that transfer the gas product of the coker to the gas plant. Also of Ingersoll-Rand manufacture, the tandem MTG 752/833 units take suction at 14.7 psia and discharge at 215 psia. They are driven by I-R turbines using steam at the same conditions as the other, and each handles 16,100 cfm. The fluid coker was designed by C. F. Braun under Tidewater's license from Esso Research & Development Corporation.





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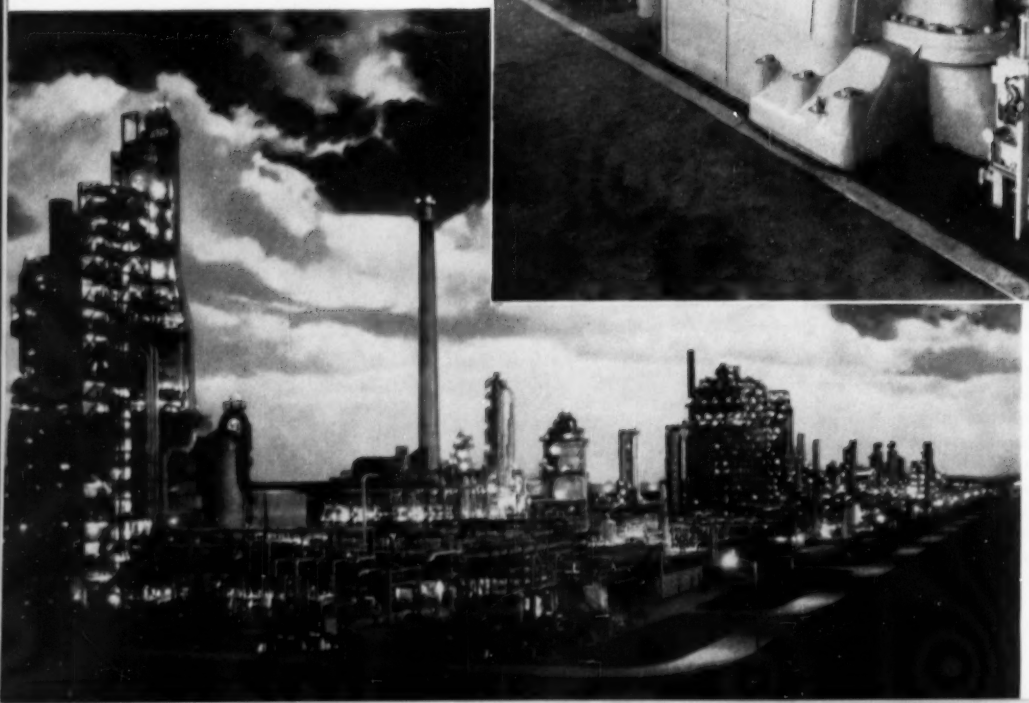
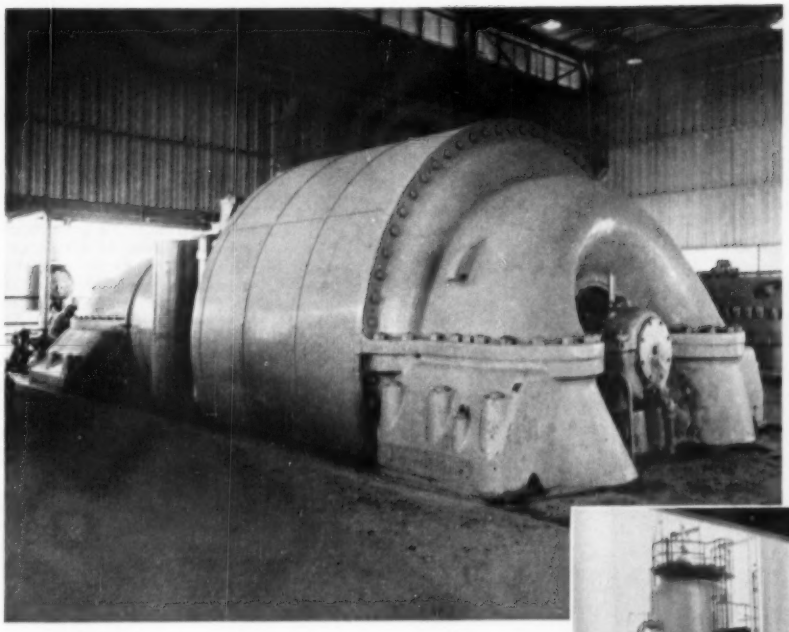
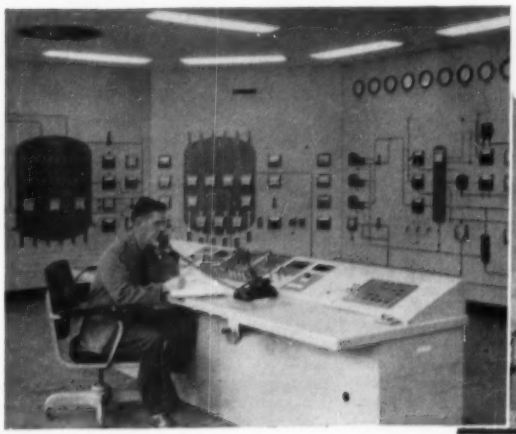




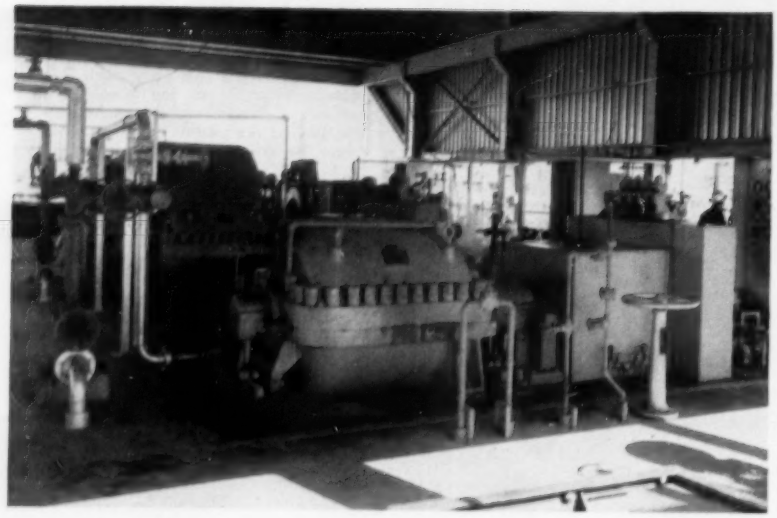
discharges at 36.1 psia. An I-R 2950-hp turbine operating at like steam conditions drives it. Control of the equipment serving so vast a unit as the cat cracker would be an impossibility without special aids. The picture below (left) shows the "cat-cracker suite," or control room. Intricately wired and piped to a bewildering variety of control and sampling points in the cracker, the gauges, dials and recording instruments located on the panels and the console keep the area operating-engineer fully posted as to the running characteristics of his portion of the refinery. Each of the eleven major process units has a control room much like the one shown. On all of the consoles a complex teleprinter automatically prepares an hourly summary of operating conditions, scans all data and prints in red those that are outside of preset limits.

CAT CRACKER

By far the dominant structure in the refinery, the huge fluid catalytic cracking unit, shown at the lower right, has a daily capacity of 102,000 barrels. Feed stocks for the M. W. Kellogg Company-designed-and-licensed Orthoflow unit are 58,000 barrels per day of straight-run gasoils from the crude distillation unit and the liquid cut from the fluid coker, plus 44,000 barrels of stock being recycled for further upgrading. The catalyst used in the big reactor acts as a chemical "traffic cop" directing the course and extent of a series of involved reactions by means of which the feed stream is converted to high-octane gasoline, light fuel oils and chemically active gases. The world's largest, it also requires the world's biggest blower to supply air to regenerate the catalyst (burn off the carbon that collects on it) and to supply heat needed for the endothermic process. Shown above, the main air blower is an Ingersoll-Rand MTA 3124 having a rated capacity of 161,500 cfm. It is driven by an 11,250-hp I-R turbine using steam at 575 psig and 750°F total temperature. It takes suction at 14.4 psia and discharges at 30.0 psia. At the right is the carrier-line blower that supplies fluidizing air for transfering and feeding the catalyst to the regenerator. Also an I-R unit, it has a rated capacity of 32,300 cfm with inlet conditions of 14.4 psia and



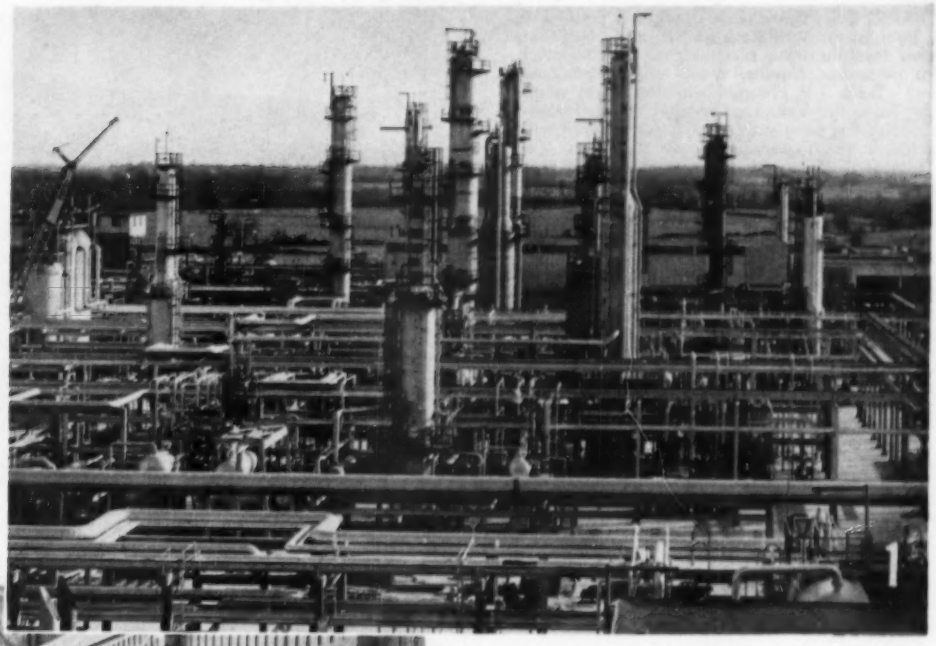
GAS PLANT

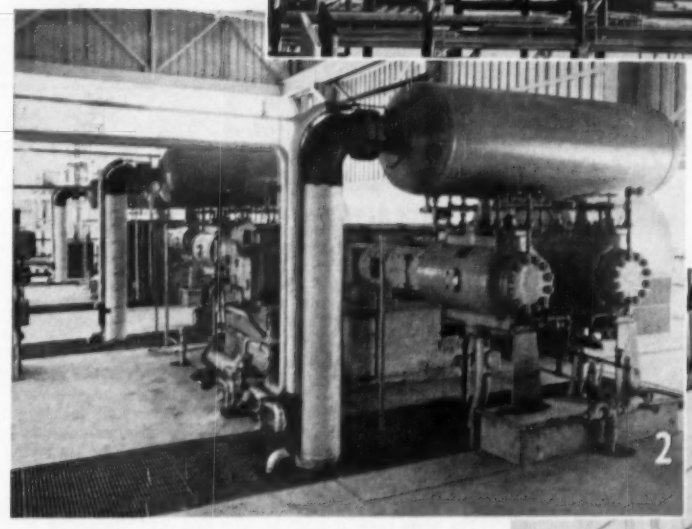


Handling all gas and light hydrocarbon liquid products from the crude, coker and catalytic cracker units as well as the gasoline products from the latter, the Braun-designed gas plant has a feed capacity of 88,000,000 cubic feet per day. In what is basically a fractionating and absorption process, sulfur compounds are removed and the gases are upgraded to several end products: a light catalytic gasoline, that is virtually ready for marketing; a polymerization-plant charge stock; an alkylation-plant charge stock; a heavy catalytic gasoline, that must be routed to the desulphurization plant; and a so-called dry gas, that is burned for fuel. An over-all view of the gas plant may be seen in the foreground of the cat-cracker picture. The illustration at the left shows two Ingersoll-Rand MTG 652 compressors handling gas in this section of the refinery. The units are rated at 18,200 cfm each, discharging at 200 psia and taking suction at 24.7 psia. They are driven by I-R turbines rated at 5710 hp, using steam at 575-psig pressure and 750°F total temperature and exhausting against a back pressure of 40 psig.

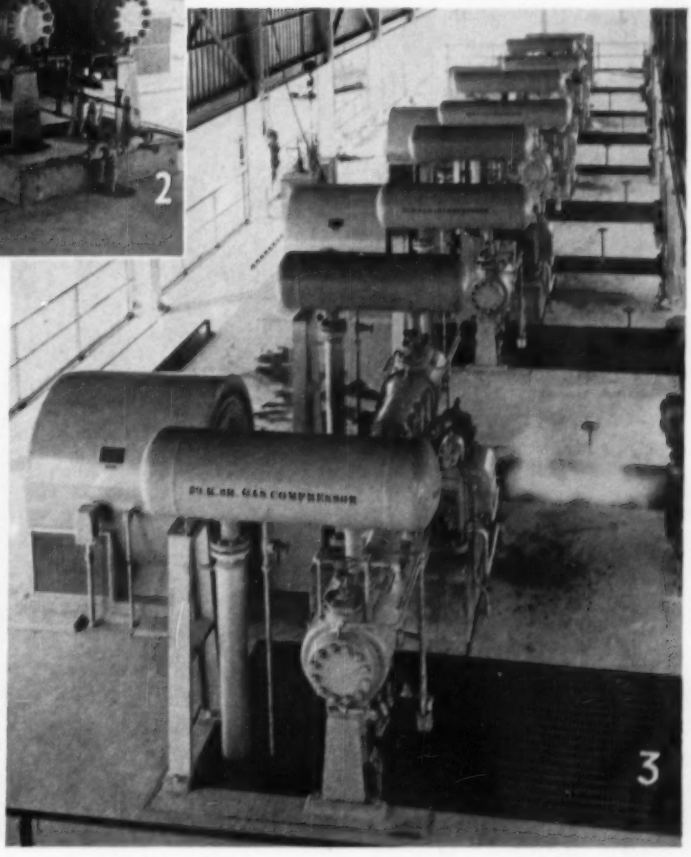
"ALKY" AND "POLY"

The alkylation and polymerization plants at Delaware Refinery are known to the engineers as "alky" (left) and "poly" (right). Basically "poly" takes the unsaturated C_3 and C_4 hydrocarbons, polymerizing them to higher molecular-weight streams, the end products being polymer gasoline—a high-octane blending stock—and liquefied petroleum gas—LPG. The polymerization plant was designed by Universal Oil Products Company and it is the licensor. The alkylation plant, receiving its charge stock of butylene and isobutane from the gas plant, reacts the two in the presence of sulphuric acid catalyst to produce alkylate (essentially isooctanes) of exceptionally high octane values. The alkylation plant was designed and is licensed to Tidewater by the M. W. Kellogg Company. Each day it turns out some 5000 barrels of light alkylate gasoline, the principal ingredient of aviation gasoline. The polymerization plant has a daily charging capacity of about 15,000 barrels per day.





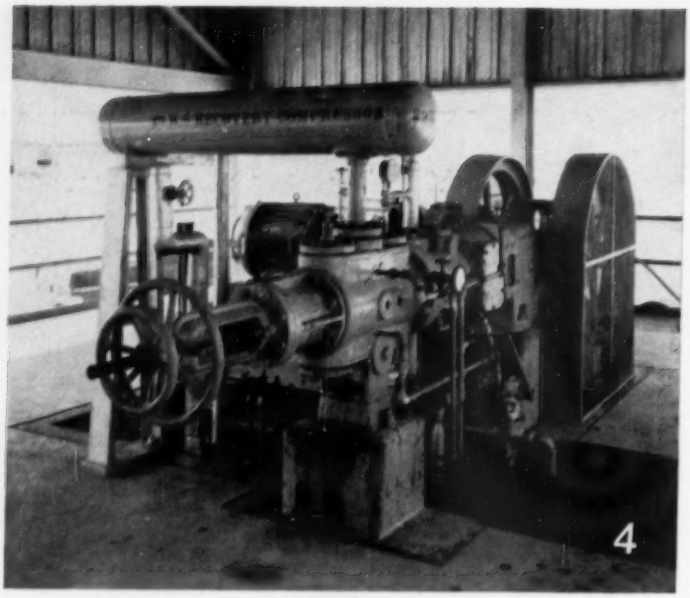
HYDRO-DESULPHURIZATION



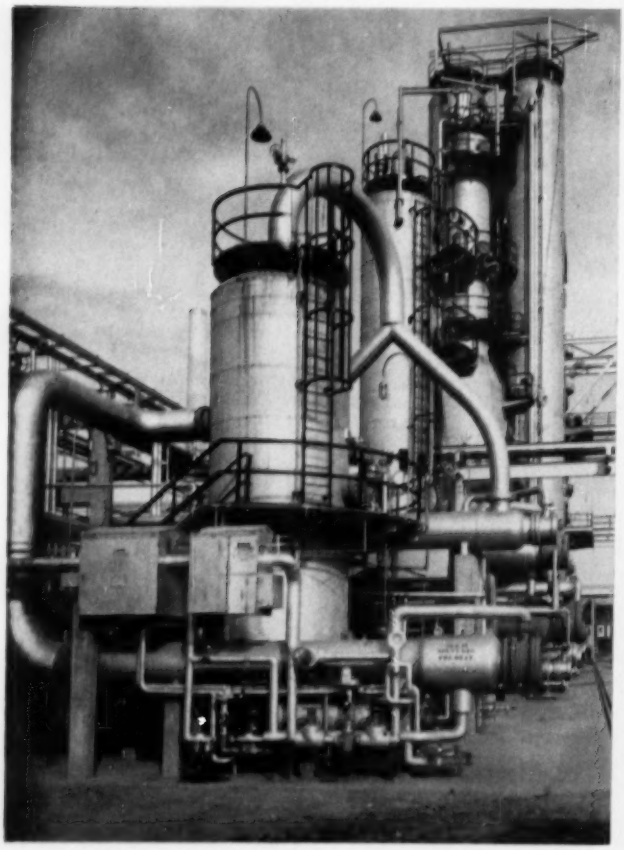
The desulphurization plant at Delaware Refinery is made up of five trains, each processing a different feed stock from varying other units. The five trains, over-all features of which are shown in picture No. 1, have an aggregate feed capacity of 88,000 barrels per day. All were designed by Braun, but Universal Oil Products Company is the licensor. In this section of the plant, odor-causing and acid-forming sulphur compounds are removed from a variety of intermediate and end products by a catalytically induced reaction between sulphur compounds and hydrogen to form hydrogen sulphide.

TRAIN 1 The charge stock for Train 1 desulphurizer is the intermediate naphtha cut from the crude distillation unit as well as light coker gasoline. This train has a daily feed capacity of 30,000 barrels. The effluent is charged to a reformer for upgrading to aromatics and isooctanes—extra high octane gasolines. No. 2 shows two Ingersoll-Rand 4HHE-NL reciprocating compressors that circulate hydrogen gas through Train 1 processes. The 800-hp units have nonlubricated cylinders to avoid oil contamination of the effluent, which in turn, would contaminate the platinum catalyst used in the reformer. The units discharge at 920 psia and take suction at 765 psia, delivering 877 cfm each.

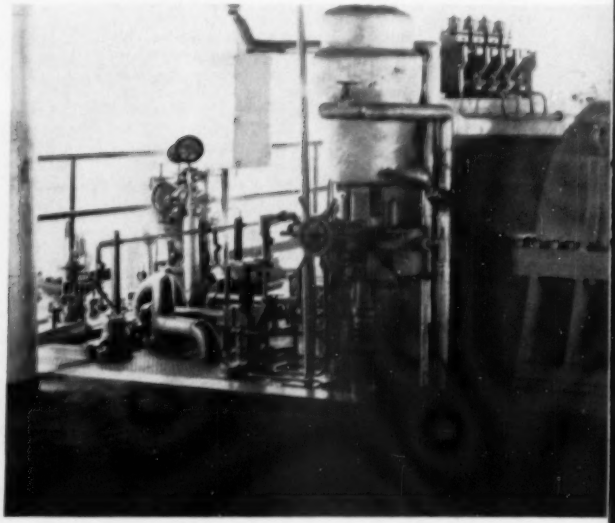
TRAINS 2-5 The charge stock for Train 2 is a light virgin distillate from the crude unit that, after desulphurizing, is suitable for blending stock for kerosenes, Number 2 fuel oils, diesel fuels, etc. Train 3 is charged with the heavy naphtha from the cat cracker after it has passed through the gas plant. Train 4 is charged with a heavy virgin gas-oil from the crude unit, and Train 5 is charged with cracked gas-oil from the cat cracker as well as a cut from the coker. Trains 3-5 also turn out blending stocks for fuel and heating oils, diesel fuels, etc. No. 3 shows the compressors used in Trains 2, 3 and 4 to circulate hydrogen gas. The two in the foreground serve Train 3 and are 2HHE 400-hp units delivering 462 cfm. The next in line, serving Train 4, is also a 400-hp 2HHE unit and delivers 431 cfm. The fourth machine is a 200-hp 2HHE, delivering 220 cfm. The last machine in the row, shown also close-up in No. 4 is a recovery or scavenging compressor that takes suction from the double compartment distance pieces on the hydrogen compressors. Gas leaking from the cylinders past piston-rod glands is trapped in these sections and pumped back into the lines by the recovery unit, an ES-2 machine delivering 70.4 cfm at 815 psia. It takes suction at about 55 psia and is driven by a 75-hp motor. All were manufactured by Ingersoll-Rand Company.



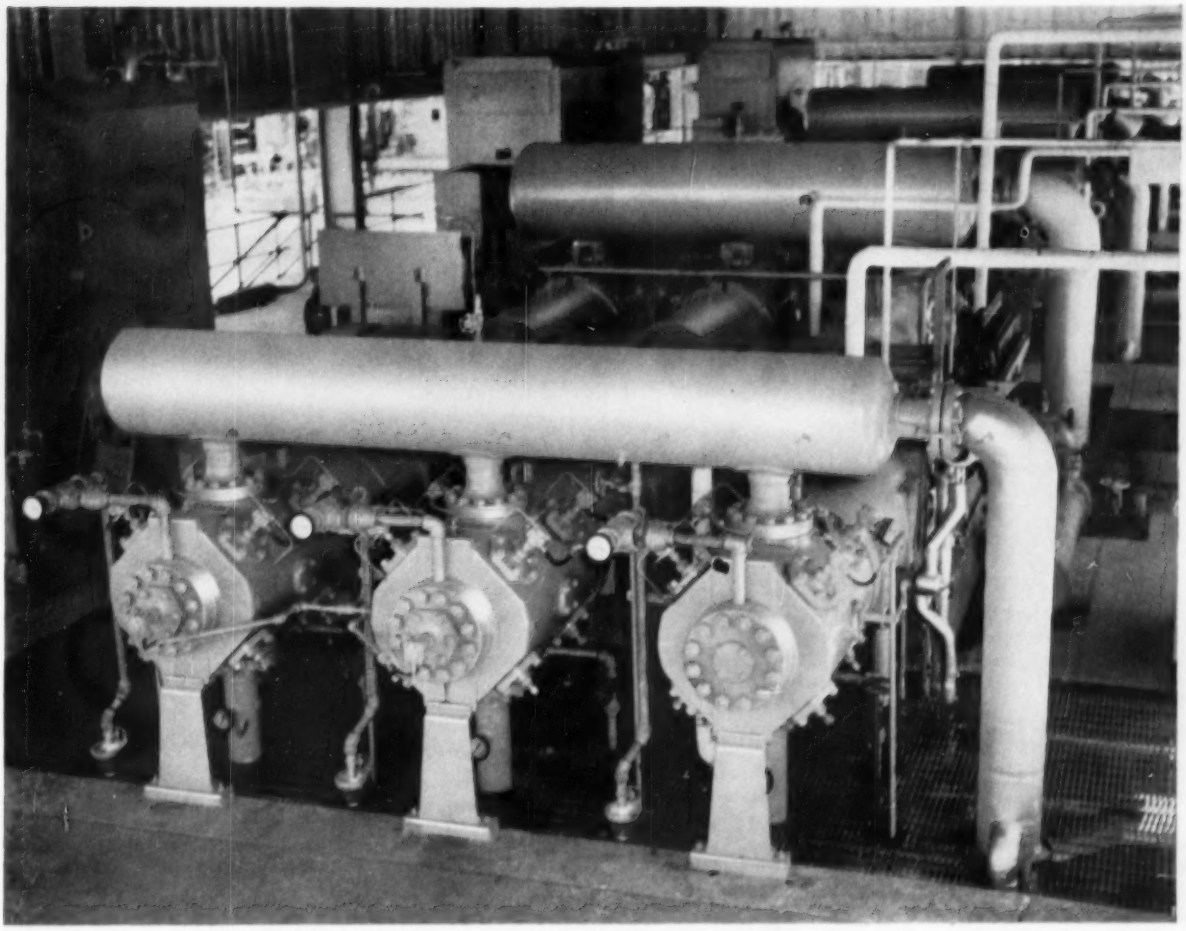
REFORMER AND UDEX EXTRACTION

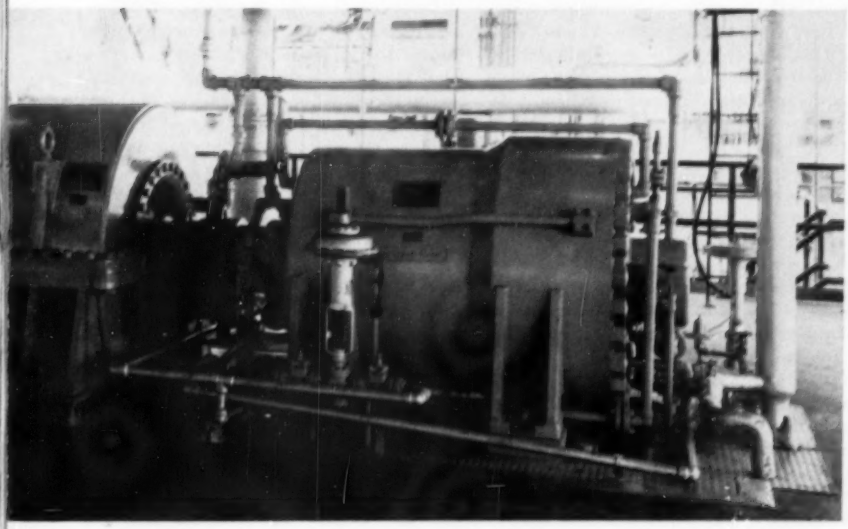


In the reformer and Udex extraction units, the intermediate naphtha cut from the crude unit and the light coker gasoline cut are upgraded to aromatics and isooctanes. The resultant high octane end products are commercial and aviation gasolines. The reformer is of Houdry design (a Houdriformer) and takes 45,000 barrels of feed per day when operating at a 50-percent recycle level—when 15,000 barrels are recycle stock. From the reformer, the effluent is passed to the UOP-designed-and-licensed Udex solvent extraction section, shown at the left, where the high octane components are selectively dissolved. The reject stream or raffinate is then recycled to the reformer for further upgrading. Recycling permits less severe reforming conditions, thus assuring a longer life for the platinum catalyst used to initiate the upgrading reactions. The reformate stream is extracted in a stripper and is the end product. Below is shown one of the two Ingersoll-Rand MTGB 542 barrel-type centrifugal compressors that pump the recycle stream back through the reformer. The 5280-hp units take suction at 475 psia and discharge at 675 psia, handling 5050 cfm.



HYDROGEN PLANT AND SULPHUR RECOVERY UNIT



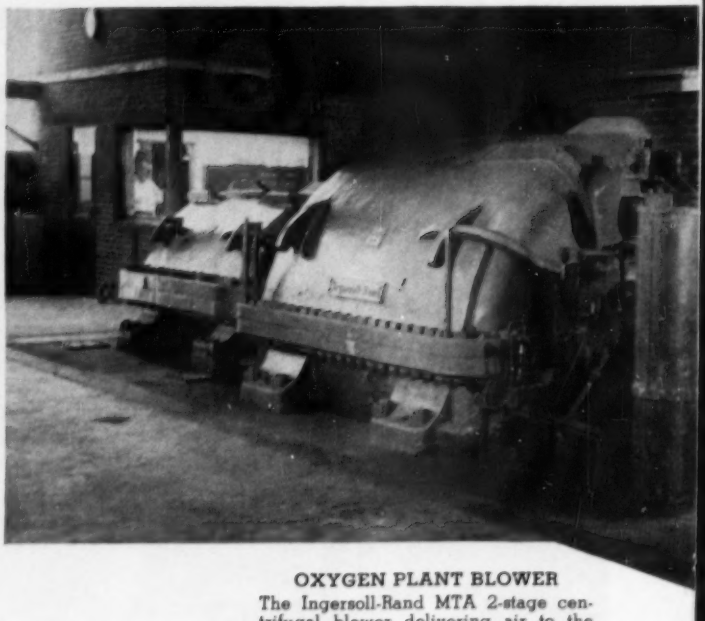


Delaware Refinery uses large quantities of hydrogen in the desulphurizer trains —much more than is available from hydrogen producing reactions in the plant. Thus additional hydrogen must be made on the premises and a 30 million-cubic-foot-per-day producer is nearing completion to supply the deficit. Hydrogen will be made by heating propane (LPG) from the polymerization plant in the presence of a catalyst to form the desired gas plus carbon dioxide. Above is shown the three Ingersoll-Rand 6HHE units that handle the output of the hydrogen producer. The 3000-hp units have inlet and outlet conditions of 130 and 815 psia respectively and each has a capacity of 2280 cfm. After the hydrogen has been used in the desulphurization plants and converted to hydrogen sulphide (H_2S), it is sent to the sulphur recovery plant where 340 long tons of sulphur can be recovered each day. In the process, H_2S is burned with air in the presence of a bauxite catalyst and reduced to water and molten sulphur. The sulphur is shipped in the molten state in insulated railroad cars and trucks. Thus it can be easily pumped, not only into, but from the transports when it is unloaded at its destination.

Oxygen Boosts Blast Furnace Production

Oxygen Enrichment, an Old Idea, Now Promises More Iron For the Nation's Mills

ROBERT JAMES



OXYGEN PLANT BLOWER

The Ingersoll-Rand MTA 2-stage centrifugal blower delivering air to the oxygen plant. The unit is made up of two compressors—low- and high-pressure casings—and is rated at 52,300 cfm at a nominal 90 psig. A 10,610-hp I-R turbine drives the tandem assembly, using steam at 800 psig and 800°F and discharging at 28 inches Hg pressure absolute. Oxygen plant service is a severe application for centrifugal compressors because of the rapidly varying output caused by the cycling of the reversing heat exchangers.

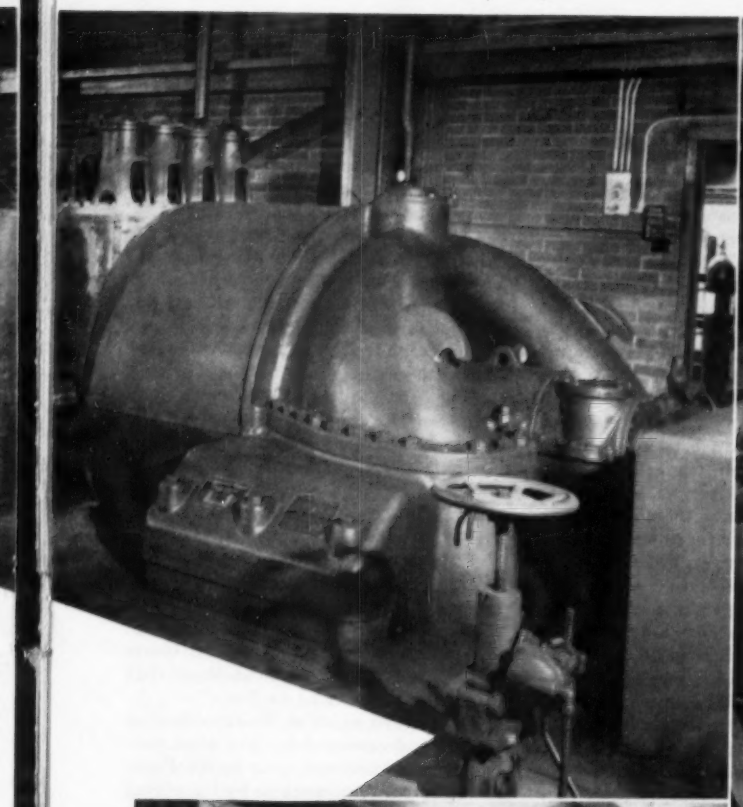
MORE than 80 years ago Sir Henry Bessemer had an idea for boosting the production of blast furnaces by adding oxygen to the air blown into them. His patent covering the basic provisions of the innovation was granted in 1876, but no economically practicable method was then available to produce the vast amounts of oxygen required. Now the gas can be obtained continuously in tonnage quantities and at costs that not only make its use in blast furnaces feasible, but may reduce the over-all cost of pig iron as well.

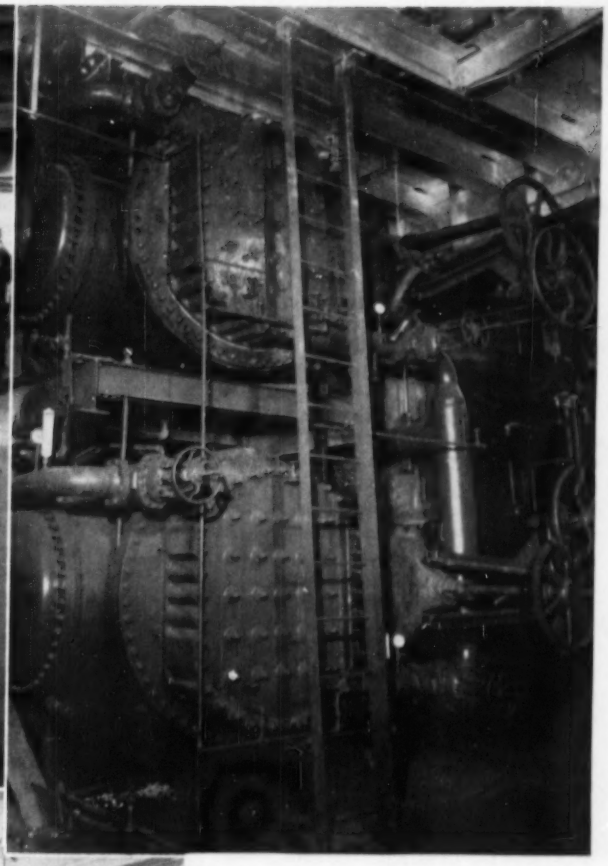
Modern day smelters call the idea "oxygen enrichment." The reason it increases iron production lies in the chemical reactions that take place in the furnace. Iron ore, coke, limestone and air are the basic ingredients for iron production. The solids are fed into the top of the blast furnace in carefully mixed and measured lots; the air, also carefully regulated, is blown under pressure into the furnace from the bottom. It supports combustion of the coke, generating heat to melt the ore and limestone and forming gases that actually reduce the ore to the metallic state. When the coke burns, an atom of carbon unites with two of oxygen to form carbon dioxide (CO_2). The latter immediately combines with another carbon atom to make carbon monoxide (CO). Then CO molecules "attack" a molecule of iron ore (hematite, Fe_2O_3; or magnetite, Fe_3O_4) and rob it of its oxygen—reduce it to metallic iron—becoming CO_2 molecules again in the process. In general, the amount of iron that can be produced by a given blast furnace depends on the amount of air that can be blown through it. In other words, an increase of 10 percent in the volume of air, or wind as smelters call it, should result in a 10-percent increase in the amount of iron produced because more coke can be burned to make additional carbon monoxide to reduce more ore.

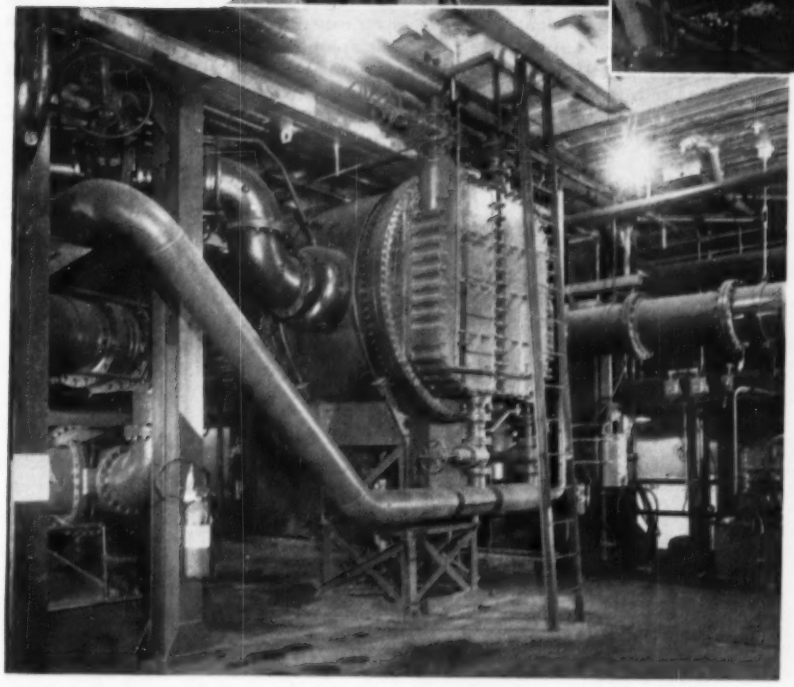
But it doesn't always work that way. Increasing blast pressure to get more air into a furnace increases the velocity of gas flow and will eventually result in a condition known as channeling—the formation of direct open passages through the coke-ore-limestone mixture that prevents intimate gas-solid contact. If gas and solids aren't thoroughly mixed, the result is that not all of the coke is consumed and not all of the available iron is gleaned from the ore. In addition the increased velocity of the gas stream results in a greater flue-dust concentration—more fines are carried out of the furnace in the blast gas effluent. The gas is moderately rich in combustibles and in the interests of making the entire steel plant operation more efficient is burned in stoves, boilers, coke ovens and soaking pits. Flue dust, of course, would foul the burners and must be removed. Of recent years the value of the iron oxides recovered from flue dust has become important as well. Flue dust removal is expensive enough to seriously affect the cost-per-ton of smelting, and consequently, it is to the best advantage of iron producers to limit its carry over in any way possible.

Oxygen enrichment is a means of getting around the difficulties of increased wind velocities. Air is made up of about 79-percent nitrogen and 21-percent oxygen but only the latter enters importantly into furnace reactions. Therefore if the percentage of oxygen in the blast can be increased, the effect on the productive capacity of the blast furnace is the same as that of an increase in wind volume. However, because the actual volume remains the same, no channeling or increase in dust carry-over results. Enrichment levels of from 1 to 3 or perhaps 4 percent are the most common at this time. (Percentage of enrichment is simply the difference between the 21-percent oxygen content of normal air and the amount in the enriched blast: for example, a 2-percent enrichment boosts to 23 percent the total oxygen level.) Iron producers also speak of "equivalent wind," which is nothing more than the volume of normal air that would contain as much oxygen as the enriched blast. Thus a 2-percent enrichment is the equivalent of a 9.5-percent increase in blast volume. As we previously pointed out, an increase in wind volume results in the same increase in iron output—in our example, 9.5-per cent added capacity.

One major steel company that not only was among the first to apply oxygen enrichment but also has one of the largest installations in the country is the Weirton Steel Company Division of National Steel Corporation. The subsidiary operates two plants: one at Weirton, W. Va., and the other at Steubenville, Ohio. The concern has 294







INTERCOOLER AND AFTERCOOLER

At the top is shown the I-R twin-unit, cross-flow intercooler through which air at 35-40 psi flows on its way to the second stage compressor casing. Each section has 1585 square feet of cooling surface and drops the temperature of the air from about 440° to a nominal 100°F. Water is circulated in the intercooler at a rate of about 4230 gpm and the air-pressure drop is less than 1 psi. The other picture shows the I-R low-fin, cross-flow aftercooler that reduces the temperature of the air from about 275° to 100°F before it enters the Air Products Company oxygen producer. Also an I-R unit, the aftercooler requires about 2650 gpm of water.

by-product coke ovens, 2 bessemer converters, 14 open hearth furnaces and 4 blast furnaces.

The pig iron capacity of the Weirton Steel division is devoted to the production of steel with the principal finished products consisting of tin plate, hot and cold rolled sheet and strip, structurals, electro-zinc-coated (Weirzin) sheet and strip and galvanized sheet.

The predecessor of the Weirton Steel Company was the Phillips Sheet & Tin Plate Company which was organized in Clarksburg, W. Va., in 1905. The company had developed into an integrated operation by 1918, at which time its name was changed to Weirton Steel Company. In 1929, National Steel Corporation was formed through the merger of Weirton Steel Company, Great Lakes Steel Corporation of Detroit, Mich., and certain assets of The M. A. Hanna Company of Cleveland, Ohio, consisting of iron ore mines and properties, blast furnace plants and a fleet of lake ore carriers. Weirton Steel Company was originally incorporated in Delaware. In 1939, it was officially dissolved and then reincorporated in West Virginia and charged with management of the Delaware concern's properties, which were absorbed into the parent company. National Steel Corporation is

a fully integrated steel producer which owns or has interests in iron ore and coal mines and also has marketing subsidiaries. For the year 1956, National Steel Corporation reported net sales and other operating revenue of $664,251,090 with a net profit of $52,502,422.

The four blast furnaces operated by the Weirton Steel Company Division are all at Weirton, W.Va., and all have been operated for a 6-year period with oxygen enriched blasts, a 450-ton-per-day oxygen plant having been installed in 1951 for that purpose. (The plant now operates at an average 490-ton-per-day output as a result of certain operating and mechanical improvements.) Enrichment levels of up to 3 percent have been experimented with and found satisfactory. However, as only about 400 tons of oxygen per day is available for blast enrichment (the remainder going for such other uses as open hearth lancing and combustion, blast enrichment for bessemer converters, etc.) the operating engineers have found it advisable to distribute the available capacity among all the furnaces. This results in an average 1.5-percent blast enrichment, 65 tons per day per furnace of the gas being required for each 1-percent oxygenation.

The four blast furnaces are approximately equal in size and each, when blown with a 1.5-percent enriched blast, has a daily capacity of between 1400 and 1500 tons of iron. At that level of enrichment the blast has 7-percent greater oxygen content than a normal air blast of the same volume and thus an increase of 7 percent in iron production is noted. Wind volume into each furnace is at the rate of about 76,000 cfm, which with the added oxygen, is equivalent to 81,500 cfm. Temperature of the preheated blast is about 1160°F and about 1650 pounds of coke is charged per ton of iron. (Specific figures for individual furnaces will vary slightly, of course, with the effective working volume of the smelter.)

The results of Weirton Steel's oxygen enrichment program were detailed in a paper presented by Julius H. Strassburger, an assistant vice president of the parent company, to the American Iron and Steel Institute in May 1956. Mr. Strassburger stated that the use of oxygen has made available another means of controlling blast-furnace tonnage and of obtaining a uniform, smooth, economic blast-furnace practice. Also, in Mr. Strassburger's opinion, the use of oxygen in blast furnaces and for other steel plant operations will increase greatly in coming years. It is even possible, he points out, that future radical changes may be forthcoming in the method of oxygen enrichment that could result in marked improvements in iron tonnage and reduction in costs. He has summarized the benefits of oxygen enrichment at the Weirton facility as follows:

"The increased production, which is obtained with no increase in gas velocities, results in a proportionate decrease in flue dust per ton of iron.

"A coke saving of 25 to 50 pounds per-ton-of-iron produced is noted and with it a lowering of the temperature of the top (effluent) gases of about 50°F. Thus losses of heat through the stack are reduced.

"The proportion of combustibles to noncombustibles in the top gas is increased because of the lesser dilutant effect of nitrogen on the oxygen-rich blast. Where a furnace would have a top gas with a heat value of about 90 to 92 Btu per cubic foot, the use of an oxygenated blast results in a 98- to 100-Btu product. This gives a higher "gas credit" to the furnace—actually a reduction in the cost-per-ton charges—in addition to producing a fuel more suitable for use elsewhere in the plant.

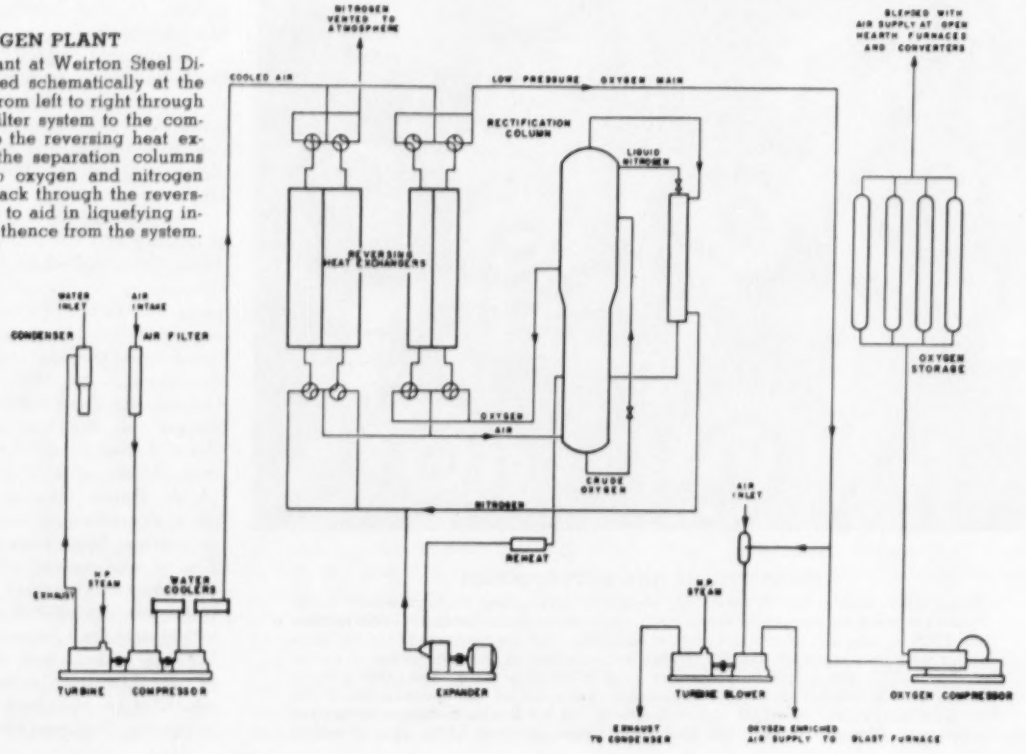
"The fact that additional equivalent wind can be blown by oxygen enrichment means that the steam cost-per-ton for the primary blast-furnace blowers is lowered. This is essentially a saving of steam which can be credited to the oxygen plant, partially compensating for the cost of running it.

"There is no detrimental effect on the expensive blast-furnace linings; the total production of iron obtained from linings in furnaces blown with enriched blasts is not significantly different than that obtained with normal air."

The oxygen plant at Weirton Steel is owned and operated by the steel producer. Designed and built by Air Products Company, it operates by liquefying air, separating the oxygen and nitrogen in fractionation columns and then passing the resultant gases through reversing heat exchangers to liquefy incoming air. Once started, the process is continuous,

OXYGEN PLANT

The oxygen plant at Weirton Steel Division is pictured schematically at the right. Flow is from left to right through the 3-part air filter system to the compressor, then to the reversing heat exchangers and the separation columns to be split into oxygen and nitrogen streams, then back through the reversing exchangers to aid in liquefying incoming air and thence from the system.



the main source of energy being a steam-driven turbocompressor that forces air into the system at a nominal 80-90 psig, thus classifying the plant as a "low pressure" oxygen producer.

Because of the oxygen plant's location in the midst of blast furnaces, coke ovens, etc., an elaborate filter system is required on the air intake. It consists of three units in series: the first two are traveling-screen, oil-bath mechanisms; and the third has a replaceable glass wool medium.

The primary compressor for the oxygen plant is an Ingersoll-Rand Type MTA 2-stage centrifugal unit delivering 52,300 cfm at 102 psia (about 87.5 psig). It is driven by an I-R turbine (10,610 hp, 3300 rpm) using steam at 800 psig and 800°F, and discharging at 28 inches Hg pressure absolute. The air end of the assembly consists of high- and low-pressure casings in tandem. The low-pressure unit discharges at 35-40 psig to an I-R twin-unit, cross-flow intercooler, each section of which has 1585 square feet of cooling surface. The two units cool the interstage air from about 440° to approximately 100°F with a pressure drop of less than 1 psi. Water circulates through the cooler at a rate of 4230 gpm.

In the high-pressure stage incoming air is raised to a nominal 102-psia pressure and delivered to a low-fin, cross-flow aftercooler, also of Ingersoll-Rand manufacture. The cooler has 2720 square feet of cooling surface and requires 2650 gpm of water to reduce the air temperature from about 275° to a nominal 100°F. Pressure drop through the heat exchanger is about 1 psi. The air, being saturated with moisture, is passed through two centrifugal separators for the removal of entrained moisture and then delivered to the liquefaction section, a heavily insulated enclosure called the cold box.

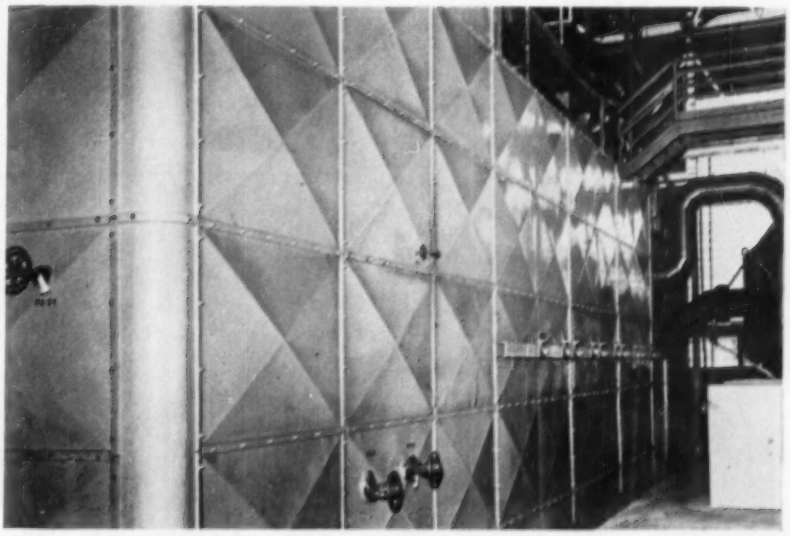
The air enters the cold box through two sets of reversing valves and is directed to the proper set of heat exchangers. In passing through the exchangers it is chilled to about minus 277-280°F. It is next delivered to a set of fractionating towers. In the first of these, the high-pressure (approximately 80 psig) column, a portion of the nitrogen is distilled off and a crude fluid consisting of about 45-percent oxygen collects in the bottom. The latter is routed to the second or low-pressure (about 5 psig) column through an expander valve. The nitrogen effluent from the high-pressure column is split into two streams, one of which is sent through a series of heat exchangers and then to the top of the low-pressure column. The other stream is routed through a centrifugal expander —a turbine in which heat is extracted from the nitrogen by making it drive a 440-volt, 200-kw generator. The refrigeration (negative Btu's) thus obtained makes up for heat leakage into the cold box. Two expanders are used when the plant is being cooled down for start-up, but, when in full operation, only one is required.

The oxygen-rich crude from the high-pressure column is separated in the low-pressure column (12 feet in diameter and 30 feet high) the nitrogen distilling from the liquid and discharging from the top of the column, joining there the nitrogen stream from the high-pressure column. The liquid oxygen collects at the bottom of the tower. There it evaporates and the end gas product is drawn off through a 12-inch pipe. Before being sent from the system it is directed to the reversing heat exchangers where it extracts heat from the intake air, being warmed virtually to ambient temperature in the process. From the exchangers, the oxygen is piped directly to the blast-furnace-blower intake or is directed through a compressor into a bank of cylinders for storage at 300 psi.

The nitrogen stream from the low-pressure column travels through another interstream heat exchanger and then combines with the stream coming from the centrifugal expander. It is routed through the reversing heat exchangers, extracting heat from incoming air and then is wasted to atmosphere. These units handle about 80 percent of the incoming air. There are eight of them and for a period of about 7 minutes, air flows down through four, and nitrogen, up through the others. Then the hydraulically operated control valves are reversed to switch the flow around. During the period of nitrogen up-flow an aluminum-foil filler in the heat exchanger is chilled to about minus 280°F. Then when air is counterflowed through the exchanger, it is chilled to that temperature. At a level in the heat exchanger corresponding to the freezing point of water, all moisture in the air stream freezes out. Similarly, at a lower level, the carbon dioxide in the air condenses and freezes. The outgoing nitrogen stream thaws the two contaminants and removes them from the exchangers.

The oxygen exchangers work the same way except that there are only two of them (thus handling 20 percent of the incoming air) and their reversing valves operate on about a 3-minute cycle. The use of the outflowing oxygen stream to thaw and remove the frozen carbon dioxide and water from the exchangers results in the classification of the plant as a "low-purity producer." The stream coming from the low-pressure column is almost pure oxygen, but is contaminated by the defrosting action that takes place in the exchangers. For blast furnace enrichment, the approximately 95-percent-pure end product is satisfactory, but for other more critical uses, the oxygen stream would not be allowed to be contaminated. This of course would affect the heat balance of the system and add to the cost of production, but it can easily be done.

In addition to the main components of the system, the oxygen plant is equipped with air dryers and heaters both for defrosting and for cool-down cycles when placing it in operation from a warm start. Normally the Weirton plant will operate for a year without defrosting, but at the end of that period the operating engineers have found it a good practice to defrost the heat exchangers



LIQUEFACTION SECTION

Above is shown a portion of the cold box—the refrigerated section of the oxygen plant. It is important to have good insulation around the liquefaction sections of the plant in order that the heat balance of the system be preserved and as little energy as possible consumed in making the oxygen.

and inspect and carry out routine maintenance work on the plant and the compressor. In that way unexpected downtime can be avoided. The plant can be defrosted in approximately 50 hours —that is, warmed up to the defrost temperature, cooled again to operating temperature and returned to production. That figure is on the basis that the compressor is not shut down. With a compressor-shutdown and maintenance period, about 4 to 5 days are required. In addition to the yearly inspection, the turbocompressor and the centrifugal expanders are checked each 8-hour shift by means of a vibrometer to be certain that the rotating elements are in correct balance.

The oxygen plant is operated on each shift by one operator and one helper. During the day shift, in addition, a repairman and his helper take care of the tonnage plant as well as several other smaller high-purity plants installed elsewhere in the mill.

Blast enrichment calls for careful control of the oxygen input so that it may be matched to the requirements of the furnace. After leaving the cold box, the gas is reduced from its discharge pressure of 5 to 6 psig to about 2 psig. If the pressure in this section builds up to more than 3 psig, an automatic bleeder wastes the oxygen to bring the pressure back to normal. If it falls below 2 psig, a valve leading to the 300-psi storage bank is opened to supply the needed make-up. The oxygen then passes through another automatic controller which reduces it to 1 psig for delivery to ratio controllers which inject it into the intake of the blast furnace blowers. The latter regulators admit oxygen in an exact ratio to the flow of air through the blower venturi control meter. Recording meters provide a check on the over-all operation.

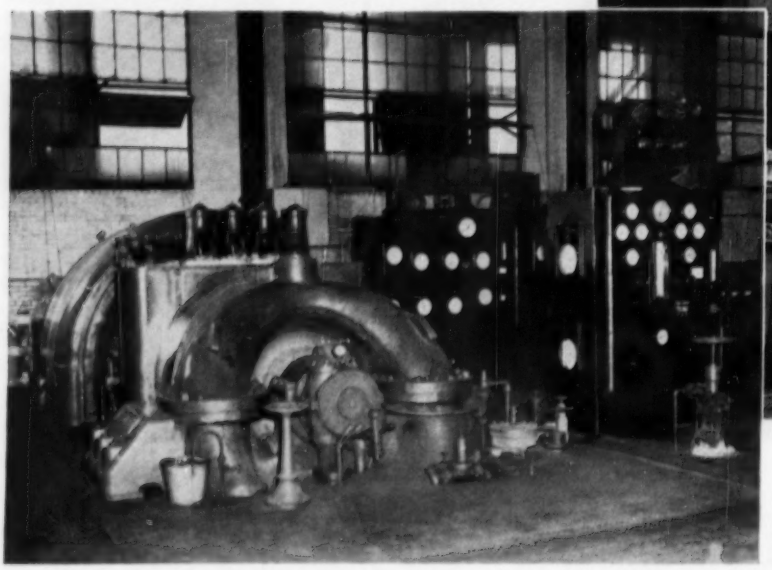
When the oxygen enrichment program at Weirton was instituted, it was found desirable and necessary to install means for regulating the moisture content of the blast. With moisture control, the melting zone in the blast furnace can be controlled to prevent "sticky" operation —binding of the charge—and also to permit free flow of bosh gases. The amount of moisture is controlled at about 7 grains per cubic foot at 1.5-percent oxygenation. Live steam is introduced into the blower intake or into the discharge to raise the water content to the level desired. The control of the steam-injection system is accomplished by means of a dew cell about 100 feet downstream from the blower. A recorder-controller receiving signals from the dew cell opens or closes an automatic steam valve as required to bring the moisture level to the preset value.

The steam itself is a valuable adjunct to the oxygenation of the blast. In the intense heat of the furnace the water dissociates making the oxygen in it available for furnace reactions. Water is about 89-percent oxygen by weight. Hydrogen, the remaining 11 percent, is also valuable as a reactant because of its rigorous reducing action. For every 1.13 tons of steam used to bring the moisture level to optimum, a ton of oxygen is thus introduced into the furnace.

The economics of a given oxygenation program are dependent, of course, on a great many variables. The level of enrichment, cost of producing the oxygen, amortization of the plant, etc.—all must be considered. At Weirton's facility, for example, the cost of oxygen, including amortization of the plant, is sufficiently low so that the added capacity resulting from oxygen enrichment is come by much more cheaply than if additional blast-furnace capacity had been added.

BLOWING AND TAPPING

At the right is shown the tapping operation at one of the four blast furnaces at the Weirton (W. Va.) facility. Each of the furnaces, when blown with a 1.5-percent enriched blast, has a daily capacity of between 1400 and 1500 tons. Below is shown an Ingersoll-Rand blast-furnace blower which supplies blast air to the furnaces. The blower, depending on the capacity of the furnace it is serving, delivers approximately 76,000 cfm at 18.7 psi. The temperature of the blast is 1160°F. When the output of the blower is enriched with 1.5-percent additional oxygen, it is equivalent to 81,500 cfm as far as furnace reactions go, but none of the adverse effects of excess blasting are present, that is, there is no increase in channeling or flue-dust carry over.



New Frontier for Paul Bunyan

Forest Service Program Increases Utah's Lumbering Operations

TRUMAN SPARKS

PREPARING FOR WINTER

Part of the stockpile that was being built up last summer to sustain winter operations at Great Lake Lumber Company's mill while logging areas were snowbound. As needed, logs are bulldozed to the right end of the building and then carried inside by chain conveyor.

LUMBERING, a bustling activity in Utah, goes almost unnoticed by the passing motorist. The industry is there though, and it is growing, but the cries of "Timber!" ring out from far back in the Uinta and Wasatch mountains and from the erosion-scarred high country in the southern part of the state—areas remote from the main arteries of travel and communication.

Production, which dates back to the days of the early Mormon pioneers, grew slowly for decades. After the railroads came it was more sensible to ship lumber in than it was to hack away at the granite-walled mountains with primitive road-building equipment then in use. In 1929, Utah's annual cut was less than 10 million board feet; in 1939, barely 15 million. Then it skyrocketed. Demands during World War II and the era following increased the annual output by 400 percent within 12 years. Lumber products during 1955 totaled 73 million board feet—a yield valued at $4.2 million. Payrolls for the men who logged and milled the timber, tabulated that year by the Utah Department of Employment Security, reached the $2.6-million mark.

Three factors have been instrumental in this upsurge: demands for local timber have increased, more and better roads are penetrating the timbered areas and the U.S. Forest Service is encouraging completion of a first-time-over harvest that not only stimulates present production but provides the best insurance for maintaining a future tree supply. To cope with the increase, several new mills have come into operation. They boast the most modern equipment. A facility near Kamas, owned by J. Blazzard, for example, is using a gang saw that can handle 18-inch cants* and slice off as many as fifteen 1-inch boards in a single pass.

Compressed air has gone to work at the Great Lake Lumber Company, 8 miles north of Heber City, and as a result, production has advanced fivefold. Three men milling ponderosa pine can turn out 60,000 board feet in an 8-hour shift. An air-controlled saw makes this possible. Manufactured by the Sierra Machinery Company of Reno, Nev., the device is operated at 120-psi pressure and has a 3-man crew. The key person in the team is the sawyer. He controls all carriage movement by manipulating two levers and two pedals that are electrically wired to solenoid valves. The valves actuate a network of air cylinders.

Logs rolling onto a platform are stopped by the flat edges of two half-moon dogs. By moving one pedal, the sawyer actuates the half-moons to flip the log onto a deck. Two steel bar flippers spring from a recessed position and slam the log tightly against three head blocks on the carriage. Another large half-moon can then be plunged into the log, thus hooking it securely against the blocks. If the log is small, a palm-controlled button releases a smaller dog to clamp the piece into position.

A forward move of one lever opens valves that release air brakes locking the carriage wheels and the log moves into a circular saw. Returning at a speed of from 44 to 51 feet per second, the carriage is stopped at its original position opposite the conveyor platform. Three kickers, recessed inside the head blocks, knock the log onto the platform in a half-roll-back motion. Then almost faster than the eye can follow, the two bar flippers spring up to send the log back against the head blocks, and another pass is made into the blade. Power is supplied by a 50-hp electric motor that spins a drum to wind and unwind a cable attached to the rig.

*A cant, or flitch, is a log that has been squared and partly reduced. After it is formed, commercial-grade lumber is sawed from it.

MECHANICAL LOG HANDLER

A Quickway machine loading lodgepole pine logs onto a semitrailer in the Wasatch National Forest prior to an 8-mile haul to the mill at Heber City. The Wasatch Forest area produced about 15 million board feet of lumber in 1956 and its output is rising. The U. S. Forest Service regulates lumbering activities in the preserve.

The outside rough slabs that are of no commercial value are ripped off during the operation and fall onto spiral rollers that move them forward out of the way. A second crew member—the tails edgerman—throws a switch causing a pneumatic flipper, called the "mechanical Swede," to kick the slab into a V-shaped bin in which it slides to a refuse chain that carries it outside to the incinerator.

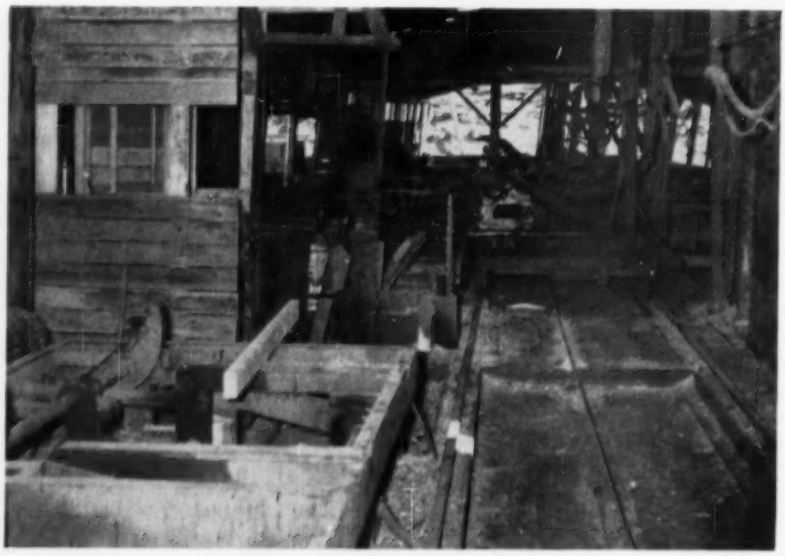
As soon as a flat face has been sawed, three small finger dogs—one in each head block—hook into and secure the newly formed cant. They are controlled by one side of a thumb-operated split-button switch. The other side regulates motors that advance or withdraw the head blocks to govern cut widths. A large dial that can be read at a glance gives the operator the volume of the cant remaining to be sawed.

As soon as commercial-grade boards begin falling off the cant, the third crewman—the edgerman—actuates an air stop to block forward movement over the spiral rollers of any ragged-edged pieces. Screws take hold and shift the strips to another conveyor that is in line with an edger for trimming. A set of heavy rollers, pneumatically raised and lowered as needed, maintains a steady pressure to keep each board true as it is fed into a secondary saw for the final operation.

Before erecting its permanent mill, the Utah lumber firm depended upon small portable rigs to process the bulk of the company's production. The equipment would closely follow the lumberjacks and about every tenth day, a time-consuming move would be necessary. Because roads into the production areas are usually impassable until June and new snows often have the region winter-bound by the middle of October, timbering was a seasonal industry. With its new installation, the Great Lake Lumber Company is now able to maintain a full-time crew and conduct a yearlong operation.

During the cold months, condensation freezes inside the air lines and plugs them. This problem was solved by wrapping the hose with heater wire. Similar coils around the levers enabled sawyers to work in –30°F temperatures without having to wear gloves.

Most of the timber milled by the Great Lake Lumber Company comes from the Wasatch National Forest in the east central portion of the state. The area is one of three main regions under development; the two others being the Ashley National Forest, running northeast toward the Idaho-Wyoming border; and the Richfield-Panguitch sector in the south. Data about the Wasatch



FEEDING PLATFORM

A chain conveyor delivers logs from outside to the platform at the lower left. The latter is equipped with air-operated dogs and flippers that transfer the logs to the carriage, which is here shown at the other end of its track at the right side. Air hose that supplies the carriage cylinders coils and uncoils along a cable at the upper right as the rig moves back and forth. Speeds up to 35 miles an hour are reached on the return stroke.

sector mirror the state-wide picture. In 1940, the cut there was about 3 million board feet. By 1955, it had jumped to 13.5 million and the schedule for 1956 was 15 million board feet. The increase is expected to continue at the rate of 1.5 to 2 million board feet per year and to level at 20 million.

Under a master plan engineered and being administered by the U.S. Forest Service, Utah's 3 million acres of commercial-grade forest land are being prepared to produce an average new growth of 60 board feet per year per acre. Rangers block out the harvest areas in small, natural sections; run the main access-road surveys so that most of the work can be conducted downhill; and then mark and estimate the volume of the trees ready for the portable chain saws. The section is next advertised for bids.

Two methods of selecting trees for cutting are in use, the selective and the commercial clear-cut. The first is generally applied in areas where ponderosa pine predominates. Only the mature and over-mature trees are removed, leaving the younger for future harvests.

SAW IN ACTION

The carriage in the left half of the picture is moving toward the camera and bearing a small log into the saw in the center. Small, air-operated dogs hold the log tight against the carriage headblocks. The large half-moon dog at the far end of the carriage is used on big logs. Slabs coming off the log while it is being faced will be kicked off at the lower left, out of camera range, by a "mechanical Swede." The man at the right waits to guide commercial-grade boards to an edger, also out of view. The output of the machine per 8-hour shift ranges from 20,000 board feet from lodgepole pine to 60,000 for ponderosa pine.

CONTROL STATION

Jack Sweeney, general manager of Great Lake Lumber Company, at the 1-man control station of the sawing operation. The levers move back and forth and are equipped with thumb- and palm-operated switches to actuate the many solenoid valves that control the network of air cylinders. The handles are wrapped with heater wire to permit working without gloves, even in minus 30° weather. The sawyer also manipulates two pedal controls that govern carriage heading.

In the spruce and lodgepole pine forests, a combination of methods is likely to be applied. The clear-cut practice is mostly a salvage operation and is carried out in areas of over-ripe, decaying trees where essentially no younger stands are left. In these spots, everything commercially valuable is marked for cutting, and the strip is cleared to make way for new growth.

This practice is also an aid in controlling insects and disease. The bark beetle, one of the biggest of the natural enemies of the Utah forests, is easily duped by this technique. During his flight season, the bug prefers and will concentrate in the log piles awaiting the trucks. It is a simple matter to leave the logs to accommodate him. Beetles and logs are hauled to distant mills where they are processed before the new eggs hatch and damage the timber.

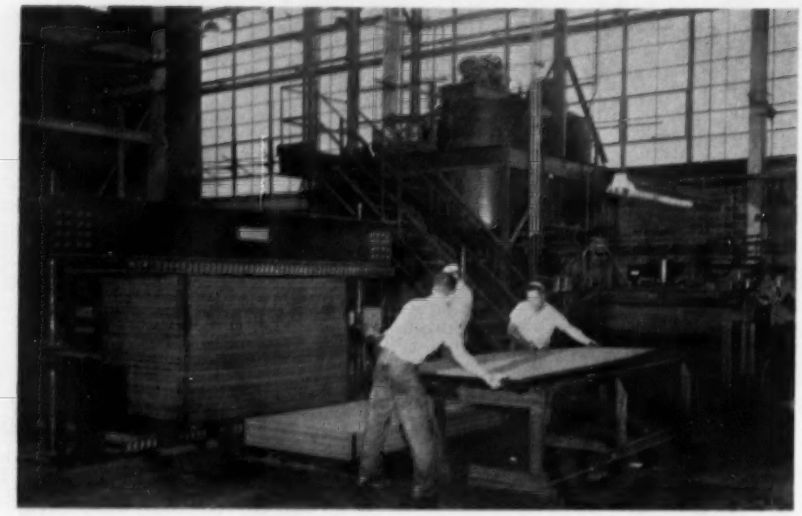
Forest Service personnel follow in the wake of the lumber crews and kill any deformed or otherwise undesirable trees that would never develop into commercial-grade timber. The use of a DuPont chemical called Ammate has replaced the time-consuming method of girdling. A ranger makes three or four slashes through the bark and sprinkles in the compound. Within 30 to 40 days the chemical has done its work. Where girdling is used, a tree may linger for a couple of seasons.

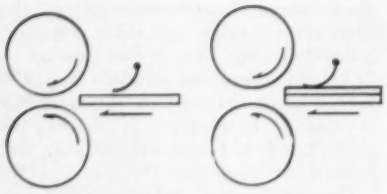
Utah forests, particularly where lodgepole pine predominates, have shown amazing power to regenerate without the need for costly reseeding. However, the seeds remain dormant for years in areas protected by an overhead canopy of lofty pines. A spot must be opened up. With exposure to sun and weather, cones dry, crack and release the kernels for germination. Within 10 years the seedlings are beginning to cover the scars left by lumbermen's saws.

Slash and existing dead timber that clutter an area after the present-day Paul Bunyans have finished and moved on, are scattered and left. This increases the fire hazard so additional fire guards are employed as a precautionary measure. However, the end result merits the calculated risk. Needles and small limbs are soon mashed into the ground by winter snows. Within 2 years decomposition is well underway and within 25, even the largest trunks are crumbling. The resulting layer of humus that caps the mountain soil helps nurture the coming crop.

Fifty years from the time the original timber is harvested, the new growth can produce mine timbers; and within 75, lumber. By the time a round has been completed, the next will be ready. Reserves in Utah's virgin growth are estimated sufficient to sustain the present volume of cutting for 107 years.

Pneumatic Roll Adjuster Aids Gluing Operation





HOW IT WORKS

The left portion of the diagram shows existing conditions when a single sheet is being fed to the gluing rolls. The sheet is not thick enough to contact the finger above it. In the other portion of the sketch, however, a double sheet is shown in contact with the finger, which sets in motion the communications chain that causes a pneumatic cylinder to lift the top roll. Ply assembly equipment is shown at the left. Sheets are run into the glue spreader at the right then placed in an electric press at the left for bonding. The pneumatic cylinder that adjusts roll height may be seen in the top center of the spreader. One of the elevated tanks in the background is a glue mixer; the adhesive is stored in the other tanks and flows to the spreader by gravity.

AN INTERESTING use of a compressed air cylinder, together with auxiliary control equipment, is found in a glue spreader made by Black Brothers Company, of Mendota, Ill. For the major part of plied-up material to which glue is applied mechanically, a single glue line is adequate between layers. However, when bonding building board, insulating board and the like, high absorption and surface irregularities make it desirable to have double glue lines between plies.

Where three sheets are bonded, using a double-coating machine, it is necessary to run the center sheet through alone, thus coating it on both sides. The remaining two sheets are laid together and run through as a single sheet, in consequence of which each one is spread on one side only. However, this necessitates resetting the rolls of the spreader because two sheets, run together, are much thicker than one.

For such work, Black Brothers installs on the spreaders an automatic roll-positioning device consisting of a pneumatic cylinder, actuated by fingers that contact the stock whenever it is of sufficient composite thickness to require raising the upper roll. A single sheet does not contact the fingers positioned above it but a double sheet does, and the pneumatic cylinder is then energized to raise the top roll to a height that has been predetermined.

When the contact fingers are lifted, they actuate a micro-switch and it, in turn, actuates a relay which controls pneumatic valves that operate the air cylinder. The valves are adjustable for any machine speed, length of stock or other varying factors. The cylinder will raise the top roll a maximum of 2 inches, which is generally adequate.

This and That

Modern Plastic Igloo

Two indian tepees, eight small totem poles, two carved grizzly bears and a 16-foot styrofoam plastic igloo will decorate the Canadian Contingent headquarters at the Boy Scouts' Jubilee in England next August. Canada's Department of Northern Affairs is lending the igloo, and part of the time it will be manned by Canadian Eskimo scouts. The structure was on display at the National Museum in Ottawa while authentic furnishings were gathered in the northland.

* * *

Giant Pictures For Oil Operations

C. H. Topping has devised a camera that is capable of making pictures 1000 feet long and 18 inches wide at the rate of 6 feet per minute. The device not only takes the photograph, but develops, fixes and drys the negative as well. By formerly used methods, distortion was encountered in transferring the image to the film. Now, a system of prisms overcomes this. Oil operators, who in the past had to paste together sections of electronic records of underground formations on long rolls of special paper, will be able to use the camera. These logs, as they are called, will have an accuracy that was not possible to attain before.

* * *

Toll Road Comes to Riviera

The toll road is a common sight to residents of the United States, but now there is a report that construction has begun on a 30-mile one that will parallel France's southern coast line. Extending westward from Nice, past Cannes to Frejus, it is the first such highway to be built there and has quite naturally caused much controversy and discussion. It is scheduled to open in 1960 and toll rates have been tentatively set at 50 to 75 cents for automobiles and $1.75 to $2.50 for trucks. The system, meant primarily for trucks and rapid travel, will be some miles inland and have two, separated, 22-foot-wide roadbeds with the sharpest curves of a 1600-foot radius and a maximum grade of 4 percent. The Autoroute Esterel-Cote d'Azur, as it will be called, will cut 8 miles off the present winding, steep and narrow route that has become so familiar to tourists seeking the scenic spectacle of the Mediterranean coast.

* * *

Underwater TV Aids Constructors

An ultrasensitive television camera, mounted in a watertight, stainless-steel cylinder 11 inches in diameter and 29 inches long, is being used to inspect canals, trawls and nets and is aid-

ing in subaqueous drilling operations. Weighing 95 pounds, the assembly has a negative buoyancy of only 12 pounds when submerged. Images are reproduced on a viewing screen that may be several hundred feet away and control is maintained there over the focus and iris of of the camera. The cylinder can be moved by either a diver or a crane, the latter being especially useful in depths greater than 200 feet. The pictures taken can be permanently recorded with an Ampex video tape recorder for later review and record. The Hancock system, as it is known, is a closed TV circuit. It was developed by HEC Corporation of Redwood City, Calif., and demonstrated in September 1955, by the U. S. Bureau of Reclamation when spillway erosion at Shasta Dam was inspected. First extensive use of the unit was made by the U. S. Navy's Bureau of Ships for salvage work and hull inspection and the U. S. Interior Department's Fish & Wildlife Service.

* * *

Antibiotics For Food Preservation

Antibiotics are slowly making their way into the food preservation field. Many products lose their freshness and flavor even with careful handling and under refrigeration. Spoilage is caused by active, multiplying bacteria that are held in check by natural living-body defenses. Several methods of application are being used. Some antibiotics are added to ice-slush baths where poultry is cooled or to the frozen cakes used aboard ships for fish. Beef can be sprayed or the fluid can be pumped through the blood-vessel system immediately after slaughter. Perhaps the largest known "hypodermic needle" is being used by fishermen in Canada and Norway as a means of preservation. They dip their harpoons into antibiotics before firing them at whales. In this instance, unrefrigerated whale meat was so well preserved that decay did not set in for 36 hours. In tropical areas where food freezing is almost unknown and refrigeration the exception instead of the rule, the potential benefits of antibiotic food preservation are vast.

* * *

More About Project Vanguard

Project Vanguard will soon be in operation as a part of the International Geophysical Year, which starts on July 1 and was covered in our April issue. At the spring convention of the American Rocket Society, the materials of the 72-foot long, 11-ton launching vehicle were listed. The first-stage propellant tanks are made of welded aluminum, while those of the second are of stainless steel. The second-stage skin is made from a relatively new substance—magnesium thorium—and its nose is of a molded phenolic material with a titanium tip. A plastic nose cone that covers the satellite is constructed in halves so that it can be dropped to save weight after it has performed its task of shielding the unit from aero-dynamic heating on its flight through the lower atmosphere.

During the meeting, the mechanical control system that will guide the big rocket was also discussed. Since the customary fins have been eliminated from the Vanguard's design to save weight, the first-stage engine will be free to swivel a little more than three degrees in any direction, thus changing its course towards the opposite direction. To control the roll of the rocket, small rotating jets will be used, the nozzles of which are capable of being rotated in less than a tenth of a second by solenoid-controlled pneumatic actuators.

The two stages were fired on May 1, in the second of a series of tests being run at Patrick Air Force Base, Fla., before the launching of the full 3-stage rocket. The second stage detached itself at a point approximately 120 miles above the earth, continued its flight until its fuel supply was exhausted and plunged into the Atlantic Ocean.

* * *

Machining Metals with Chemicals

One of the most recent advances in machining techniques that has proved itself to engineers in the metalworking industry is chem-milling—an etching method that has made possible great cost reductions, especially in aircraft plants. With the process, it is possible to "mill" intricate patterns in sheet and plate metals—usually aluminum or one of its alloys—in a fraction of the time required to do the job mechanically. Often the method is used where others won't work. Tolerances may be held to as close as 0.002 inch. The part to be milled is thoroughly cleaned, dipped in an etchant-resistant masking compound, dried and scribed with the desired pattern. The mask is stripped from the areas to be cut away and the part immersed in etchant, usually an acid or strong alkali. Careful control of the time spent in the etching solution determines the depth of the cut. Undercutting, or eating away of metal underneath the mask, is allowed for in scribing the patterns, an operation reminiscent of the metal shrinkage allowances made in foundry molds. After the etch is complete, the remaining masking material is stripped and the part is washed in a neutralizer. Cuts of different depths can be made on the same part by step-stripping; that is, by removing the mask from the cuts that are to be the deepest first; starting the etch; and then at the proper time, stripping the protective coating from other areas. Attempts are being made by some companies to work out a means by which light-sensitive masks can be used so that the job can be done in much the same way that engravings are made. The process was developed by Manuel Sanz at North American Aviation Company of Downey, Calif.

* * *

Crane Scales Save Weigh Time

The old adage that time is money is nowhere more evident than in industry. Even saving a couple of minutes on a single operation is considered to be worth while, especially when the task is a repetitive one. At the Ellenville, N. Y., shops of Channel Master Corporation, large bundles of tubing for the firm's line of television antennas are transferred from one station to another during processing and are weighed each time for inventory control. Built-in Baldwin SR-4 crane scales are used. The units are equipped with electronic mechanisms that indicate net weight on a dial. By previously used methods, the bundles were taken to a platform scale for weighing—an operation that consummed a minute or less. The job was done so many times, however, that during a single shift, the minutes added up to a considerable length of time. The built-in scales were installed and now the transfer and weighing are done simultaneously, saving as much as 4 minutes with every bundle.

* * *

Gilsonite Ore Pumped to Oil Refinery

American Gilsonite Company has laid a 6-inch pipline to transport semisolid oil over 72 miles of virtually uninhabited country from Bonanza, Utah, in the Uinta Basin to Gilsonite, Colo. Gilsonite ore, as it is called, is mixed with water at the mines in Bonanza and is pumped through the line at a rate of 700 tons per day, three pumping units being used to do the job. In the refinery at the other end, the slurry mixture, that looks like coal, is converted into high octane gasoline and fuel oil to be sold in the Rocky Mountain area and sulphur-free coke for aluminum producers all over the country. The wet-mining technique will eliminate fire hazards common in transporting oil-bearing substances.

The span itself transverses some of the most rugged terrain in the West, including a 8500-foot pass in the Book Cliff Mountains and two large canyons. Costing approximately $2 million, it is said to be the first privately financed venture of its kind.

Tire Service Trailer for Truck Terminal

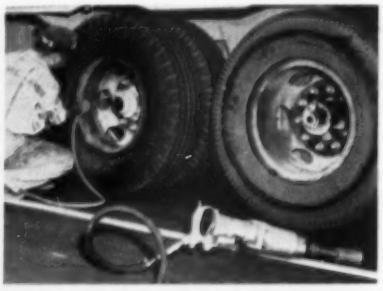
A MOBILE tire shop is paying off for Great Southern Trucking Company, the largest motor carrier operating wholly within the southern United States. At its Atlanta, Ga., terminal, the trucking company has in operation a trailer equipped with a compressor, an Impactool for running and removing wheel lugs and an air jack to lift the huge tractors and trailers. It can carry eighteen big tires as well. Designed by C. J. Nassimbene, shop superintendent, and built in the Atlanta shop, the rolling maintenance vehicle has reduced terminal trailer movements for tire repair by 50 percent and repaid its $1100 cost in only 6 months.

Eighteen feet 10 inches long, 6 feet 7 inches wide and 5 feet 10 inches high, the unit carries an Ingersoll-Rand Model 242 FGT compressor delivering 20 cfm at 175 psi. The compressor is V-belt driven by a Wisconsin 6.9-hp gasoline engine equipped with a push-button electric starter. The 2-stage machine and its driver are mounted on a common base plate which in turn is welded to a 30-gallon air receiver. The unit has ample capacity to run the I-R Size 534 Impactool, which is kept in a tool box just behind the compressor, or to operate the jack. The power package is mounted at one end of the trailer and air is piped to hose connections at each end of the carrier.

ROLLING REPAIR SHOP

It carries 18 tires on racks, an air jack (in a slot beyond the compressor) and an Impactool (in a tool box on the compressor platform). The trailer is towed to the point of work and has a small retractable wheel in front for supporting that end while it is standing free. The tire slots have no bottoms and are thus self-cleaning. A ground clearance of only 6 inches makes it easy to load and unload the heavy tires. A small ramp is provided to aid in loading the skid-mounted jack.

In operation the trailer is loaded with the tires called for in the job sheets and is hooked to a pickup truck for towing to the semitrailer needing service. The air jack is used to take the weight of the vehicle and the Impactool to loosen the nuts on the wheel of the tire concerned and to run them down when replacing it. If the tire needs air, it is inflated to the required pressure on the spot. The big freight-carrying trailers stay parked at their assigned locations and neither tractors nor hostlers are required to move them. Prior to the adoption of the tire-service trailer, 24 to 30 trailer movements per 8-hour shift were required, often resulting in a disruption of duty schedules for the affected vehicles. Now only half as many are required, and the accompanying confusion is minimized.



TIRE SERVICING

An Ingersoll-Rand Size 534 Impactool is being used (left) to remove retaining nuts on a wheel. A portion of the air jack can be seen at the right. Tires can be inflated (above) by means of an air hose running from the trailer's compressor. In addition to its primary function of tire servicing, the trailer can supply air power anywhere on the premises, serve as a standby for the shop compressors and even charge the service lines of trailers for setting brakes.

Editorials

GONE FISHIN'

OUR editor since 1932, C. H. Vivian, has retired from active direction of COMPRESSED AIR MAGAZINE. His name first appeared on an article in this publication, in June 1926, that concerned an irrigation project in his beloved home state of Colorado. The story was written while "Viv," as we know him, was a free-lance writer. He joined the staff in 1927 bringing with him 13 years of experience in newspaper work and of writing general and technical articles. Since then his accurate and readable articles have appeared in almost every issue. Many have been reprinted and thousands of copies distributed to readers over the world. He personally wrote much of our Fiftieth Anniversary (March 1946) issue, collecting and putting down a great deal of previously unpublished material dealing with the early development and work of compressors, rock drills, pneumatic tools and pumps. A graduate geologist, holding a degree from the University of Colorado, he personally visited most parts of the United States and some of Canada for first-hand coverage of construction, mining and industrial operations. He leaves behind a heritage of accurate and complete reporting and readable writing.

C. H. VIVIAN

An outdoorsman all of his life, "Viv" has literally and figuratively "gone fishin'." We wish him luck and lots of big ones. His name no longer appears on the masthead as editor, but his vast experience and recognized abilities as a writer and editor are not completely lost to us. He plans to contribute articles to this magazine, including some, as he puts it, "that I've always wanted to do, but never had the time."

MAPMAKERS FOR A NATION

THIS year the U. S. Coast & Geodetic Survey celebrates 150 years of service to the nation. The first technical bureau ever created by the Federal Government, it was born February 10, 1807, by executive order of President Jefferson. A director, Ferdinand Rudolph Hassler, a Swiss geodesist, was chosen on recommendation of the American Philosophical Society. He gave to the bureau the organization and scientific background it required to establish itself permanently, and the insistence upon precision that has characterized the Survey to this day.

In the early days surveying instruments were crude and progress was slow. Not the least of the troubles confronting the engineers was the lack of adequate transportation both on land and sea. Yet the quality of the work was exceptionally high; present day surveys of areas charted in the mid-nineteenth century almost invariably fail to turn up major discrepencies.

Two great overseas jobs have been undertaken by the Coast & Geodetic Survey: Alaska and the Philippine Islands. The purchase of Seward's Folly led to the initiation, in 1867, of a long and still unfinished story of charting the coasts and waterways of that mineral-rich land. The Philippine survey was begun about the turn of the century and today the Philippine nation has complete charts of the 7000 islands making up the archipelago. These, of course, are in addition to the hundreds of thousands of charts of our own coastal areas as well as many hundreds of volumes of so-called pilot books in which are listed sketches and verbal descriptions of thousands of landmarks that aid the captains and navigators of ships and airplanes to find their way. Just keeping the charts now available up to date would be sufficient reason for the continuance of the Survey's work. Along with that formidable task, the demand for more and better sea and air charts has kept its engineers and staff more than busy. Approximately 45 million nautical and aeronautical charts are issued each year.

From the beginning the Survey has been required to develop many of its own methods and equipment to keep pace with technological developments in transportation. Many of its scientists and engineers have advanced theories that now are firmly rooted in our beliefs about geophysical and geological events. They pioneered the use of the wire drag for detecting hidden rocks and shoals, echo sounding (sonar), and radio and electronic position-finding techniques, and were early advocates of aerial mapping, all of which proved valuable to our armed forces as well as to peacetime vessels and aircraft. The basic theory of tides was developed by a Survey engineer, who also constructed a tide predicting machine still in use 45 years later.

INDUSTRY AND THE SCHOOLS

FUNDAMENTALLY, a nation progresses only as its schools progress. And, as living grows more complex, the problems of educators multiply. There are so many more things to learn now than there were 50 years ago that a burden is placed on both teachers and students. Two world wars, the development of revolutionary methods of communication and transportation, new conceptions of the nature of matter—these and many other events and discoveries have changed school curriculums immeasureably. Our grandparents had to absorb the contents of only a few comparatively thin textbooks. In contrast, even grade school pupils of today normally carry bigger and heavier brief cases than their fathers do. Old courses have been expanded, new ones have been added. Yet the school day, week and year are no longer than they were at the turn of the century.

On the other hand, educated people are more in demand than ever before. Industries compete for them and so do individual companies within industries. Industry has never been so concerned with our school system, which is another way of saying that the opportunity for industry to lend a helping hand to the schools was never greater.

An example of how this can be done is found in the teaching aids made available to junior and senior high schools by the American Petroleum Institute. This is an association of some 9000 companies concerned with the finding, producing and refining of crude oil. The activities of these firms touch the lives of all of us in many ways.

Materials for teachers in this Petroleum School Series include a ready reference handbook of general information on the industry, filmstrips and charts. Six booklets for students, averaging 16 pages each, cover separate phases of the story of petroleum. All of them are regularly revised.

The program was undertaken after an extensive survey had determined that the schools wanted it and obtained their ideas on what it should include. Ninety percent of those interviewed were classroom teachers or their supervisors or principals. The objectives are to provide up-to-date unbiased information about the oil industry, to explain its role in American society and increase the interest of oil men in their local school systems.

Perhaps there is food for thought here for other branches of industry that affect the nation's daily routine. Many of them already have worth-while educational programs that could be readily expanded to reach the secondary school level.

SAVING WITH AIR POWER

Air Power Lights The Way

A UTAH open-pit copper mine has put compressed-air power to work lighting the rear of its ore trains. No electrical system was carried on the pit cars, but nevertheless a rear "headlight" was required to illuminate switches and for safety purposes. It would have been difficult and quite costly to equip all the cars with lights and to run an electrical system through each. Nor would it have been practical to equip only one car per train with a light and make that one serve as a "caboose" because the end carriers were constantly changed when trains were made up. What was needed was a device with a self-contained power plant that could be easily moved from one car to another to provide a powerful light and that was dependable and rugged enough to withstand the rigors of ore-train service.

AIRLITE

The I-R Airlite with its special lamp and fittings adapting it to ore-train service is shown (left). The Airlite is lightweight —8¾ pounds—and powerful—150 watts at 115 volts when supplied with air at 90-psi pressure. The device, which also can be obtained for 220-volt operation, delivers at a frequency of 400 cycles per second. A special U-shaped bracket (above) is used to hang the device on the ladder at the rear of any ore car.

That big order was filled by an Ingersoll-Rand Size AL150 Airlite, a small (approximately 5x7¼x5 inches) air-powered alternating generator that delivers 150 watts at 115 volts. For the job at hand, a 150-watt sealed-beam lamp was mounted on the 8¾-pound Airlite and a special bracket attached so that the whole assembly could be hung on the rungs of a ladder at the rear of any car. A short air hose, equipped with a railroad coupling completes the assembly. In operation the unit is placed on the end car, fastened securely with a simple chain and lock-pin device and the hose coupled or "gladhanded" into the train's air-brake system.

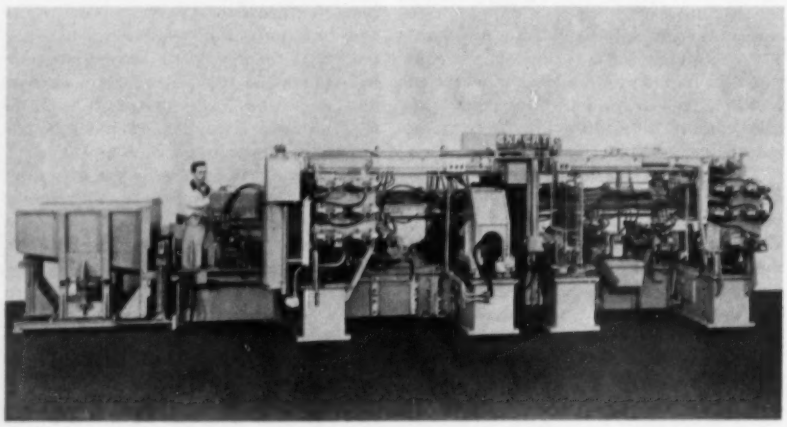
Welding Automation

WELDAMATION is a 7-station, in-line processing machine developed by Expert Automation Machine Company. For the first time, it is said, metal-working and machining operations are combined with welding, assembly and testing processes. The unit shown assembles and welds a flange to one end of a steel tube, performs three separate machining operations on the other end and tests the finished product—automotive steering-column assemblies—at a rate of 400 units per hour.

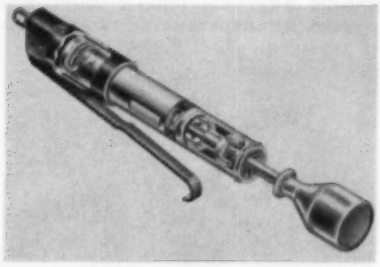
Bundles of tubes to be worked are placed in a hopper. An air-powered lifter plate then transfers them upward to an inclined feed magazine where they slide, one at a time, into a reciprocating grooved shuttle plate that moves them to a transfer bar mechanism, a longitudinally reciprocating bar containing seven clamping "fingers." The clamping devices move the parts from one station to the next in an inverted U-shaped path. The bar itself is hydraulically operated and each "finger" has its own cylinder.

To begin the operation, a flange is manually loaded into a feed track that guides it to station one where it is oriented and assembled to one end of the tube by means of a hydraulic press. The group then moves to the second station where the two parts are spot welded together. Four slots are pierced in one end of the tube and a second weld is made at station three. Moving to the fourth position, the unit is clamped and a hole is drilled near the tube's end. The third spot welding is done on the flange, which is then reamed at the fifth stop to remove any build-up of weld. At section six, it is tested by axial pressure exerted on the flange. If the assembly undergoes this satisfactorily, it is marked with a steel stamp and deposited, at the final station, on a waiting conveyor.

A hydraulic system of about 30 hp is available to actuate the equipment. Adjustments are provided to permit handling two different tube and flange components, thereby allowing short change-over periods for new steering-column assemblies. Because modular construction is used, additional stations can be incorporated in the design with a minimum of change-over time and cost. Depending on the part specifications and production requirements, either in-line or rotary-index machines can adapt the Weldamation principles.



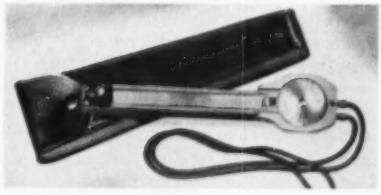
Industrial Notes



A short, lightweight and compact "sand-wiper" rammer with a double-phase front-seal design has been developed by Ingersoll-Rand Company and is available in three sizes. The first seal is of neoprene felt and wipes the piston rod clean, preventing the entrance of particles into either the bore of the guide or the barrel. Behind this is an air seal—a leather ring encircling the piston rod. Air pressure against its face holds it tightly against the rod to provide a positive seal with minimum friction. Power and speed are kept at a maximum because the packing is self-adjusting to compensate for wear. The unit's piston rides in a honed, ductile-iron barrel, reportedly reducing frictional losses by 65 percent. The material used in these two parts has good lubricating characteristics, thus allowing a closer fit; the result is a higher percentage of useful work obtained from each cubic foot of air.

Other features of the tool are its rubber-faced throttle valve that is said to close tightly even if small particles of dirt are trapped on the valve seat, and a flapper valve that is specifically designed to pass any dirt that may be in the air line. Exhaust air, cooled by expansion, is led through the barrel into an annular exhaust chamber to lower the temperature at the point where the operator normally holds the rammer.

Circle 1E on reply card



To measure distances to objects from 8 to 100 feet away from the observer, especially to inaccessible points, Edmund Scientific Company has developed a range finder that is said to be accurate within 2 percent. It is useful in all types of outdoor construction and maintenance work. The 6-inch long instrument has an eyepiece in one end through which two images are seen. One is in natural color and the other in contrasting gold. By turning the knob, the images will coincide. On the other end of the device is a dial with a foot scale inscribed on it. When the coincidence is exact, the dial indicates the distance. A leather carrying case is supplied with the unit.

Circle 2E on reply card

Elsey Corporation has designed a diaphragm control valve unit that reportedly replaces standard and 3-way units. Within one body are combined the repair and arrangement principles of most control-valve hook-ups together with stream flow shut-off and by-pass devices. All inner parts are interchangeable with the company's "convertible" diaphragm control valve. It is designed so that repair or replacement of valve seats or change from normally-open to normally-closed valve postion can be accomplished in line and under pressure.

Circle 3E on reply card

The Bellows Company has introduced Lubri-Air Controls for filtering and lubricating compressed air to assure efficient operation and long service life of

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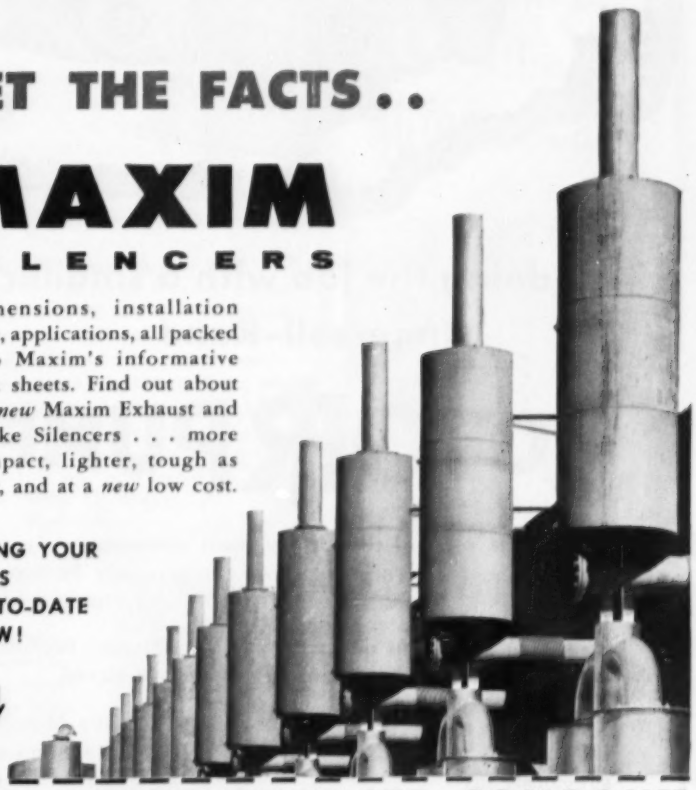

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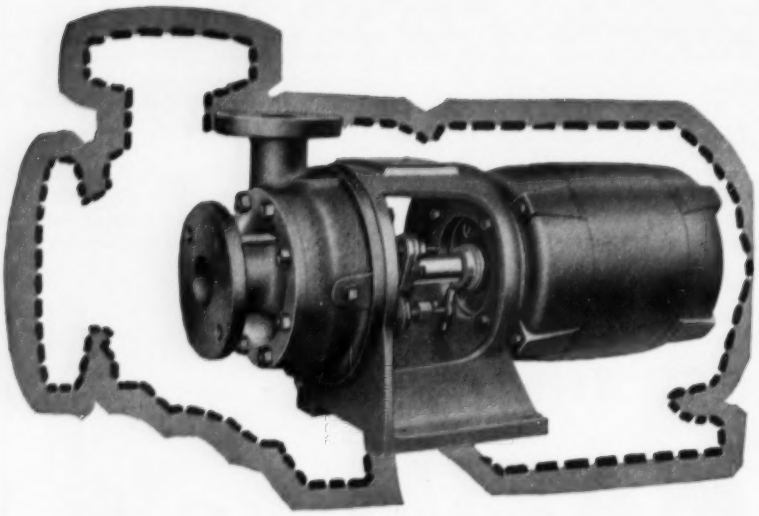

by doing the job with a smaller Ingersoll-Rand

MOTORPUMP

By reducing original cost. Many plant operators say yes, because liquid handling operations can generally be done by I-R Motorpumps of lower horsepower than other pumps.

By saving on weight and space. Both, probably—because Motorpumps are so compact and efficiently designed.

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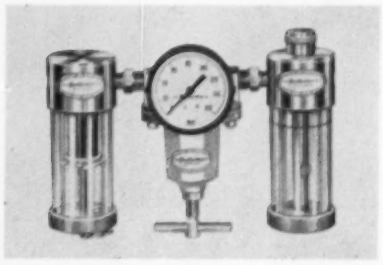
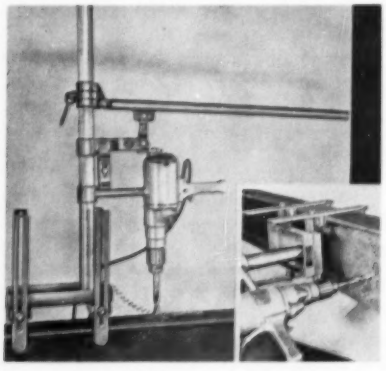
pneumatic equipment. Twin baffle plates create centrifugal circulation of incoming air, thus forcing water and heavier dirt to the base of a plastic reser-



voir. Lighter particles are trapped by a Bendix Skinner 40-micron filter. Oil is introduced to the air stream by capillary action through a porous bronze wick and reportedly functions even during intermittent use. Models are available in four port sizes: ⅛, ¼, ⅜ and ½ inch.

Circle 4E on reply card

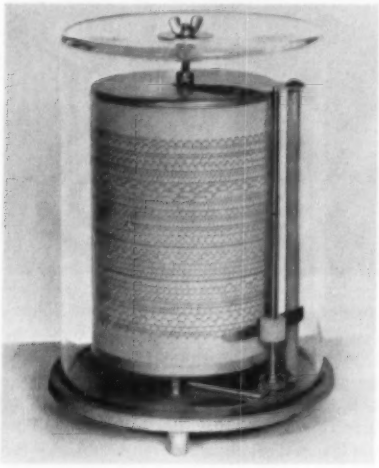
Lance Iron Works has announced a portable, radial drill press for vertical, horizontal, overhead or flat operations. It is designed for all standard, heavy-



duty, portable air- or electric-operated drills and eliminates the necessity of bringing heavy, unwieldy tools to the job or for turning work to be drilled, countersunk or tapped. Easily carried, operated and controlled by one man, the device reportedly will not fall off a workpiece under any circumstance. It swings in a 360-degree radius and can be clamped and rolled on any size, shape or type of metal or wood with a safe, sure grip. *Circle 5E on reply card*

Utilizing only a stylus rather than the customary ink or lead, MD-Jr., is an operations recorder designed by Gorrell & Gorrell. It is useful not only on oil burners, boilers, pumps, air conditioners and the like, but also for obtaining records for piece-work, production and cost studies. The unit consists of a drum that revolves at various speeds depending on the requirements. Up to 400 linear inches may be recorded on one chart and the stylus moves uni-

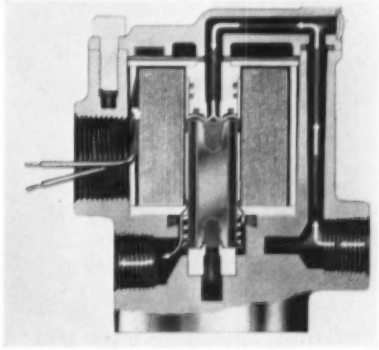
formly ⅛ inch with each drum rotation. Since each 24-hour period is aligned with the preceding one on the chart, instant comparison of data at a given time each day is possible. The charts consist of a tough, colored paper coated with an opaque white wax. The wax acts as a lubricant for the stylus which when rubbed over an area, causes the wax crys-



tals to become transparent, thus showing the basic paper color. It is said to be effective in temperatures of from -30° to 150°F and has, with a few precautions, an indefinite file life. Many base colors are available for rapid identification of various applications.

Circle 6E on reply card

Continuous internal cooling of its solenoid coil and self-cleaning effects of its actuating plunger prevent overheating of Valvair Corporations' Speed King solenoid pilot valves. The operating



medium, carrying entrained lubricant, passes through the center of the solenoid, between the plunger and its encasing tube. It is said that this provides the internal cooling and continuous plunger lubrication. The coil is completely sealed from the operating medium by multiple Hy-car seals. Incased in molded epoxy resin, the coil is guaranteed against burn-out. The stainless steel plunger and spring are the only moving parts. For handling air, oil, water, inert gases and vacuum, for direct, sub-base or manifold mounting, the units are available in 2- and 3-way models for separate control applications. Solenoid coils are supplied for 3 to 300 volts d-c and 6 to 550 volts a-c, 25 to 60 cycles.

Circle 7E on reply card

Capable of operation with finger-tip control at all pressures from vacuum to 3500 psi, an aluminum, 3-valve manifold with five ports has been developed for use in air distribution boxes by Robbins Aviation. It is said to feature easy, complete overhauling without disturbing the plumbing.

Circle 8E on reply card

Indicating and controlling pressure and temperature are the functions of the Series 1450 line of small, low-cost instruments. Each is housed in a plastic-impregnated, fiber-glass case and can be used outdoors or in corrosive atmospheres. They are removable for easy servicing. Temperature ranges for the instruments are said to be –400° to 1000°F; pressures range from 30 inches Hg vacuum to 5000 psi. As pneumatic signal receivers they can accommodate 3-to-15-, 3-to-18- or 3-to-25-psi signals. All exposed parts are either fiber glass or 316 stainless steel. A polyvinyl chloride gasket seals out moisture and dust. They are suitable for surface, panel or pipe mounting and are available from Fischer & Porter Company.

Circle 9E on reply card

An air-powered Pittsburgh lock hammer for turning locking edges on sheet metal has been developed by Modern Manufacturing Company, Inc. Utilizing an Ingersoll-Rand percussive air hammer, the tool is said to do the job in one pass and to accomplish four times as much work as when using conventional tools. The standard hammer can handle 30- to 24-gauge sheet metal, but others for heavier gauges are also available.

Circle 10E on reply card

"Go—No Go" is an automatic Brinell hardness tester for production-line checking of metals. Two parts at a time are placed in holders on the edge of a large, circular worktable, the movement of which is controlled by a preset timer. The table automatically rotates to the first station where twin grinding

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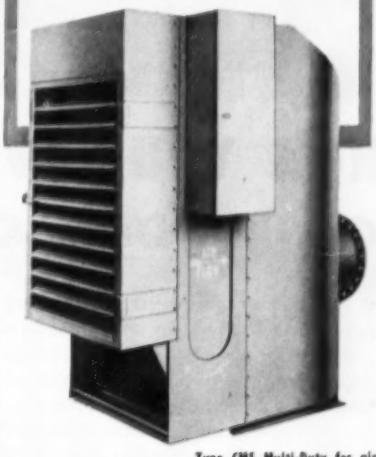
Multi-Duty
Filters
Assure
Clean Intake
Air
Automatically



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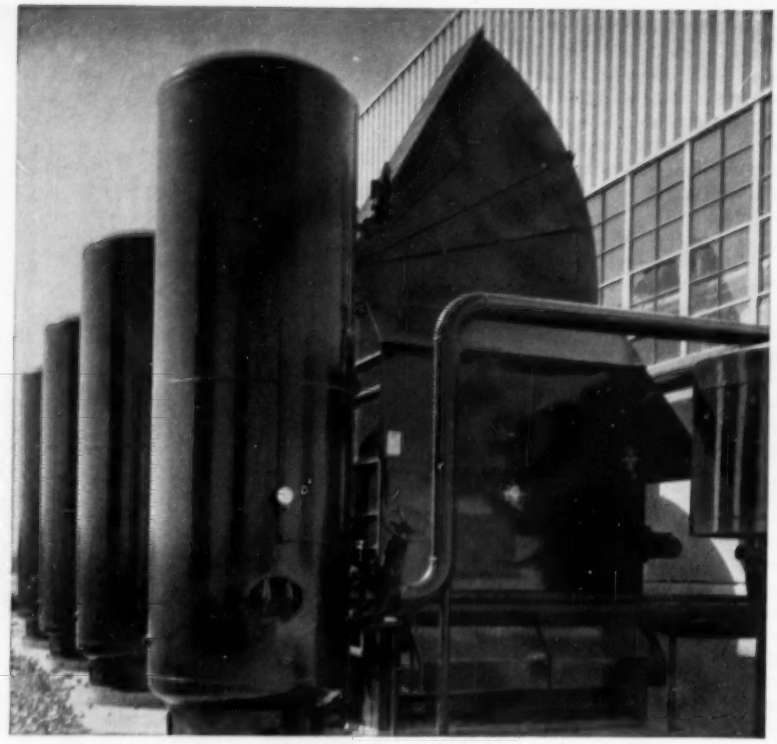

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Extra, for no cost, the drier air gives you a better operation and lower costs in the use of all air-operated tools and machines, paint spraying, sand blasting or moisture-free air cleaning. Water saving also means less expense for piping, pumping, water treatment and water disposal, or you get the use of water elsewhere in your plant where it may be badly needed.

Niagara Aero After Cooler assures all these benefits because it cools compressed air or gas below the temperature of the surrounding atmosphere; there can be no further condensation in your air lines. It condenses the moisture by passing the air thru a coil on the surface of which water is evaporated, transferring the heat to the atmosphere. It is installed outdoors, protected from freezing in winter by the Niagara Balanced Wet Bulb Control.

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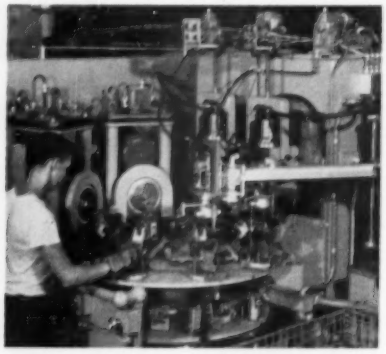
Circle 20A on reply card

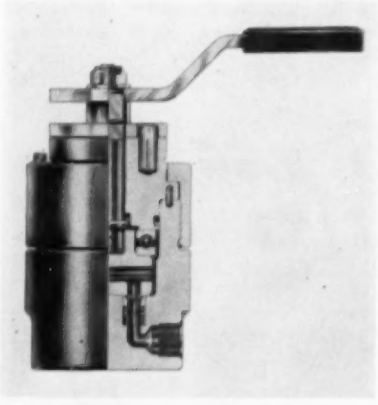
wheels prepare a small, smooth area. At the second stop, a standard 3000 kilogram Brinell load is applied and at the same time, with what is said to be extreme accuracy, the depth of the impression is electrically measured. Read-



ings of this are transmitted to the "Go—No Go" memory units at the third station, where, according to their hardness, parts are either picked up by a conveyor belt or dropped into a reject pile. The machine was originally designed by Tinius Olsen Testing Machine Company for checking odd-shaped, 10-pound automotive forgings and is said to have operated at a rate of 1000 per hour.

Circle 11E on reply card

Tufline is the name of a series of non-lubricated stainless-steel plug valves produced by Continental Manufacturing Company. They utilize low-friction Teflon in the sleeves to permit free turning under all operating conditions. Fully en-



HIGH-PRESSURE VALVE

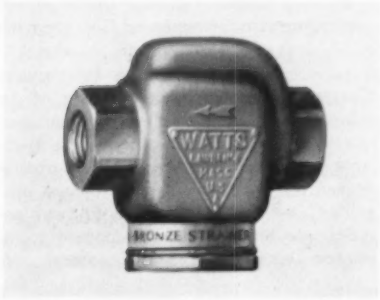
Barksdale Valves has developed a Shear-Seal shut-off valve rated for liquid or gases at pressures of 10,000 psi. It reportedly will withstand surges to 15,000 psi without damage and it is designed for a burst pressure of 40,000 psi. Units will be furnished for pipe and tube or any preferred, special, high-pressure connection. The manufacturer is prepared to supply complete information on its application in individual high-pressure applications.

Circle 12E on reply card

closed metal construction, a shield-type epoxy-coated wrench, no exposed Teflon and a 4-bolted cover give maximum protection against fire or line shock. Absence of lubrication prevents contamination, and sleeve wiping action keeps the plug free from adhering solids and liquids. Units are recommended for liquid and gaseous corrosives, solvent and slurry services, and for hydraulic and pneumatic services where standard-type valves will not seat because of entrained solids, polymerization, crystalline deposits and the like. According to the manufacturer, these valves are in the 150-pound class and will operate continuously from –150° to 400°F, under pressures of from 230 psi to high vacuum. Sizes range from ¼ to 2 inches and have either a screw or flanged end.

Circle 13E on reply card

Watts Regulator Company has announced an all-brass strainer, designated as Series 137. It is designed for air and gas applications that require fine straining and is claimed to be especially suited for keeping regulators clean. It contains a removable porous-bronze element that is said to trap particles as small as 0.004 inch. It is available in ¼-, ⅜- and ½-inch pipe sizes and is useful with pressures as great as 500 psi.

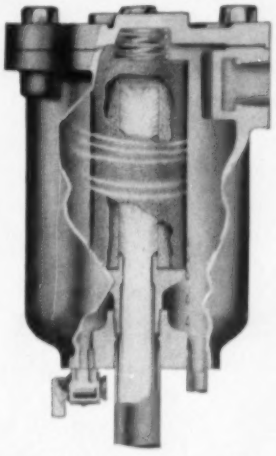


Circle 14E on reply card

Protective Closures Company, Inc., has expanded its line of CaPlugs (polyethylene closures) to include caps and plugs in ten different designs. They are said to be suited for dust and moisture seals; shipping protectors for fittings, valves, hydraulic components, and the like; and as masks for dipping, painting and vacuum plating. Molded of tough, yet flexible, polyethylene plastic, they are impervious to common chemical reagents and reportedly will not chip, break or shred under severe conditions. The ten standard designs, stocked in more than 300 sizes and described in detail in a series of file folders, include tapered CaPlugs with wide, thick flanges; non-threaded caps and plugs for electrical receptacles and connectors; threaded caps and plugs for tight sealing of threaded fittings; threaded pipe plugs with square heads adaptable to manual

ADAMS PORO-STONE AIR FILTER

designed to remove oil, water and foreign matter from compressed air lines with minimum pressure drop.



The R. P. Adams Poro-Stone air filter is engineered to efficiently remove entrained oil, water and pipe scale from compressed air lines. Liquid droplets and solids being carried by the gas stream are first removed by centrifugal action in an annular chamber. Secondary filtration is achieved by passing the air or gas stream through a Poro-stone unit. An automatic trap can be provided to discharge the residue from the cyclone chamber.

At rated capacity the filters operate at a maximum pressure drop of only ½ lb., thus insuring delivery of line pressure to the point of consumption.

The units require virtually no service or maintenance — thereby insuring continued trouble-free, low cost performance.

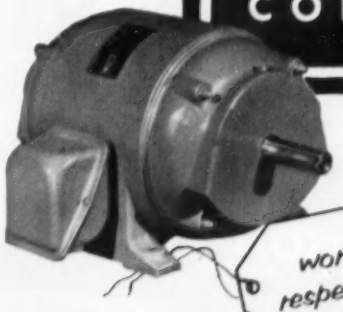
ADAMS Poro-Stone air filters are available from stock in sizes to suit your needs. For further information, write today for Bulletin 117, R. P. Adams Co., Inc., 209 East Park Drive, Buffalo 17, New York.

Circle 21A on reply card

BROOK MOTOR CORPORATION

1 TO 600 H.P. A.C.

SINCE 1904



world's most respected motor

3553 W. PETERSON AVE.
CHICAGO 45, ILL.

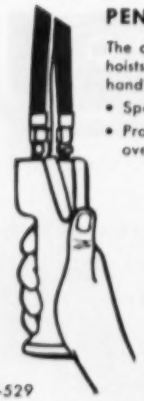
Circle 22A on reply card

small, lightweight air hoist gives you greater VERSATILITY

Ingersoll-Rand AIR-BLOC combines safety, ruggedness and mobility...

Move it anywhere . . . hang it anywhere . . . the I-R AIR-BLOC gives you versatility you never thought possible for speedy handling of loads up to 1000 pounds. No mechanical brake to fail . . . load can't drop even if air pressure fails. Responsive throttle control and automatic up-down-stop permit extremely accurate handling. There's a size just right for your job.

Portable winch-type Utility Hoists, in a wide range of sizes up to 4000 lbs., are also available from Ingersoll-Rand.



PENDENT THROTTLE

The only complete line of air hoists with convenient "one-hand" control.

- Speeds spotting of loads.
- Provides "Finger-tip" control over full range of speeds.

Ingersoll-Rand
11 Broadway, New York 4, N.Y.

AIR HOISTS up to 24,000 lbs.

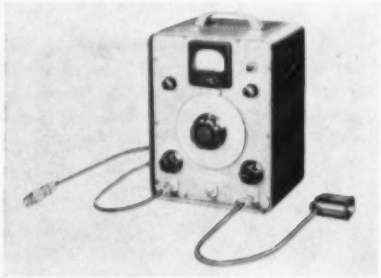
8-529

Circle 23A on reply card

or mechanical tightening; non-threaded sleeve caps to fit snugly over the outside diameter of tubing; and non-threaded tubing plugs with flanges to fit flush with the outer walls of tubing.

Circle 15E on reply card

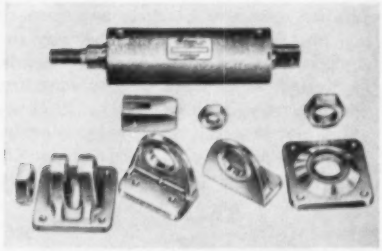
Rate of pressure change under severe conditions can be measured directly with a SLM transducer system, Model PI-114, a product of Kistler Instrument Corporation. Through the use of an adaptor and resistor element, electrical current generated in the Swiss-made quartz-crystal transducer (pick-up) is measured by an electrostatic-type amplifier and appears on a standard oscilloscope or recorder. Reportedly, response is rapid (15-microsecond rise



time) and the instrument has high sensitivity for studying cylinder processes on engines and compressors. It is especially useful for indicating combustion and detonation data. The transducer will withstand temperatures to 600°F without special air and water cooling and will perform equally well in a range of either 0 to 1 psi or 0 to 1000 psi. It is thus suited to pneumatic, hydraulic and diesel-combustion systems.

Circle 16E on reply card

Modernair Corporation has developed a series of cylinders of 1½- and 4-inch bores designed for pneumatic or hydraulic service to pressures of 200 psi. Called Economair, they supplement the original



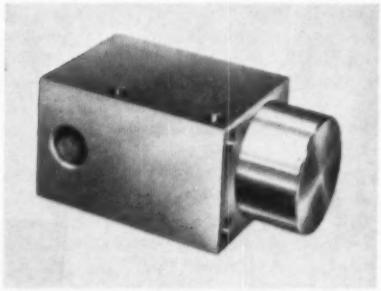
line of 1⅛-, 2- and 3-inch sizes. Internal feed-ring locking of the heads to the barrels eliminates bulky head castings. Flange, clevis or L-type mounting brackets are interchangeable. Reportedly materials throughout resist corrosion—barrels are made of drawn, seamless brass tubing; ground and polished rods are of stainless steel; and heads and pistons are of aluminum. O-ring seals are used throughout, and standard cushion and non-cushion models are offered.

Circle 17E on reply card

Dirt particles and entrained liquid droplets are said to be removed from compressed-air streams by either of two types of filters manufactured by Air-Maze Corporation. One is for use where relatively small quantities of extremely clean air are needed. Its special felt filtering elements are reported to have an efficiency of more than 95 percent on particles as small as 1 micron. The other variety, of metal-disk design, is expressly suited for handling high-temperature air. It has an extended filter area, a low initial pressure drop and reportedly gives long service. Special materials can be furnished for use in corrosive atmospheres.

Circle 18E on reply card

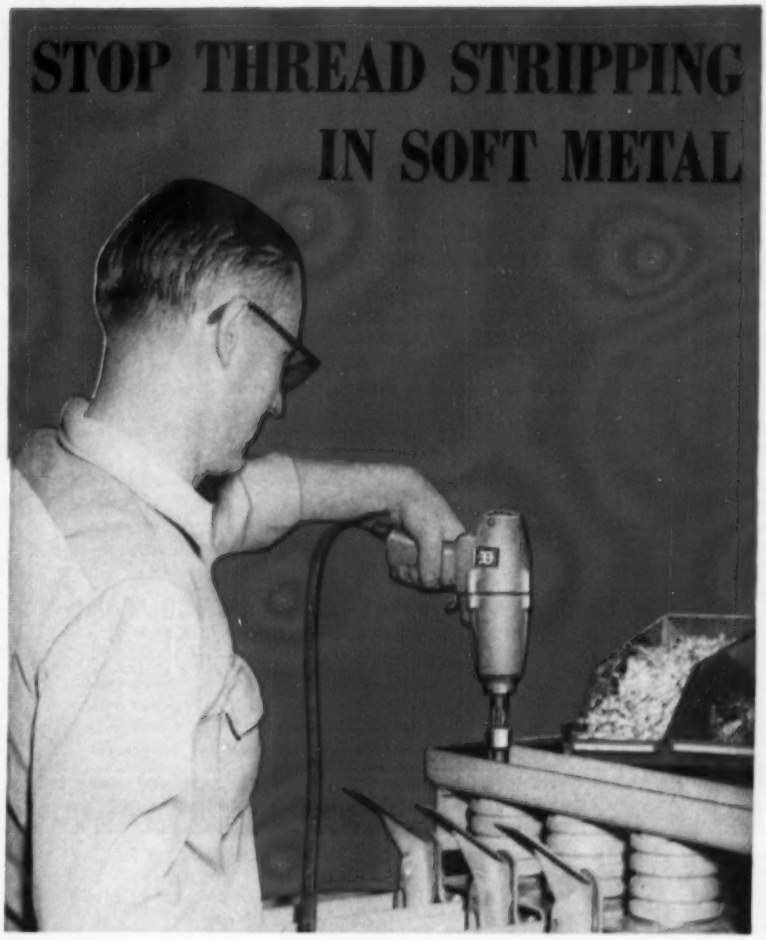
Pneutronic is the name given to Fielden Instrument Division of Robertshaw-Fulton Controls Company's pneumatic-electronic level controller, now available in an explosion-proof model. Although designed for such liquids as water, acids,



SMALL WORKHORSE

Toolmor air cylinders, although of compact size, provide a full-line-pressure power stroke of ⅜ inch or more. They have heavy, hardened-steel pistons and are available from Burklyn Company with standard, ball, swivel, thrust or tool-blank piston ends.

Circle 19E on reply card



here's how it's being done with Ingersoll-Rand TORQUE CONTROL impactools!

If you assemble soft metal threaded parts, such as aluminum or bronze, take a look at the improvement record made by this large electrical manufacturing company.

Parts spoilage is substantially reduced and product quality greatly improved since changing from conventional air powered wrenches to new Ingersoll-Rand Torque Control Impactools for running nuts and cap screws. These revolutionary Impactools shut off instantly and automatically when the preset torque is reached. No more stripped threads . . . and every fastener is precisely tightened for top quality.

Call or write for bulletin 5170, or ask for an obligation-free demonstration.

8-523

Ingersoll-Rand
11 Broadway, New York 4, N.Y.

Circle 24A on reply card

NON-FLUID OIL

TRADE MARK REGISTERED

6 IMPORTANT REASONS FOR USING NON-FLUID OIL FOR ALL PNEUMATIC TOOLS & EQUIPMENT

* NON-FLUID OIL is used and approved by practically all leading manufacturers of air tools.
* NON-FLUID OIL reduces wear by as much as 80%.
* NON-FLUID OIL increases tool speeds up to 25%.
* NON-FLUID OIL gives complete protection from rusting — even during idle periods.
* NON-FLUID OIL prevents gumming or sticking of pistons and valves and swelling of fiber blades.
* NON-FLUID OIL extends useful life of cup leathers by 3 to 5 times.

Write today for informative bulletin 550 and a free sample of NON-FLUID OIL "NR" Grade. State type and make of tool on which test will be made.

NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 MADISON AVE., NEW YORK 17, N. Y.
WORKS: NEWARK, N. J.

1890 61 1951 YEARS OF LUBRICATION SERVICE NON-FLUID OIL TO INDUSTRY

WAREHOUSES

Birmingham, Ala.		Greensboro, N. C.
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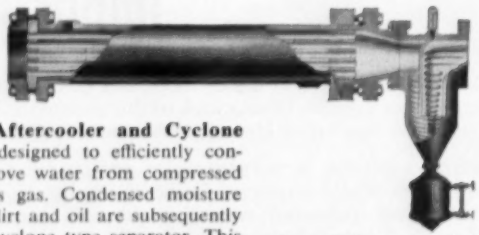
Charlotte, N. C.	Springfield, Mass.	St. Louis, Mo.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

Circle 25A on reply card

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
209 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

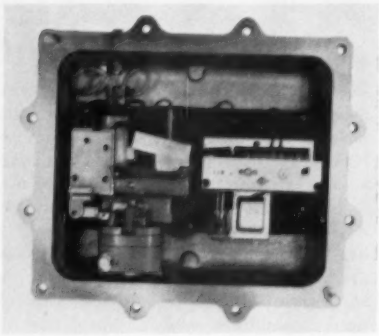
For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases, a pressure drop of ½ psi is assumed at a maximum working pressure of 150 psi.

This wide range of sizes enables the cost-cutting application of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

Circle 26A on reply card

alkalies, oils and aqueous solutions, it has also been used, with specially designed probes, with granular solids. Probes are of rigid rod-shaped structure without moving parts. Two models are available: No. 111 that produces an increase in air output with an increase

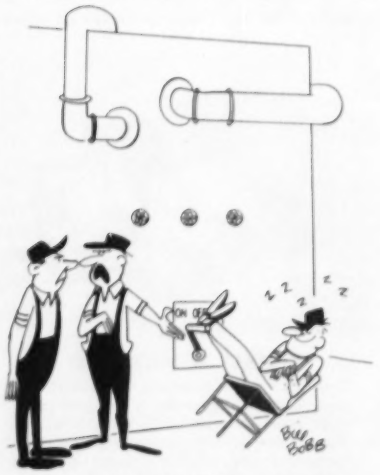


in measured level, and No. 112 that produces a decreased air output with an increase in measured level. According to the company, consultation services of application engineers are available for the proper selection of the system to be used in any given installation.

Circle 20E on reply card

Glasstite is a liquid "glass" roofing compound that is guaranteed by Mallard Manufacturing Corporation to remain watertight for at least 12 years without renewal. Fiberglass threads in the mixture spread over the area like a spiderweb and permanently bind the roofing together. The result is a tough, non-cracking, flexible surface for roofs, storage tanks and pipes. It is available in 5-gallon drums of which one containerful is enough to surface 200 square feet. Reportedly it is easily applied, dries in 12 hours and withstands a temperature range of –25° to 140°F.

Circle 21E on reply card



"—and Harrison here, wakes up at 5:00 PM and shuts off the plant!"

BRIEFS

Belgium's oldest technical journal observed its centennial last May. The publication, *La Revue Universelle des Mines* is the official organ of the engineering society, Association des Ingenieurs sortis de l'Ecole de Liege. To mark the occasion, a 3-day conclave called International Days was held, the general theme of which was scientific research and industry. Speakers from France, West Germany, Great Britain, Holland, Switzerland and Belgium were presented, and the sessions covered the fields of coal, chemistry, mechanics and minerals, electricity, nuclear energy, civil engineering, metallurgy and metals.

●

About 3000 companies in the United States spend $5 billion annually and utilize approximately 500,000 workers on research programs. Raymond Elwell, director of The National Science Foundation says the country as a whole earned $2000 to $5000 for every $100 spent in research and development during the last 25 years.

●

Although the Queen Elizabeth Hotel in Montreal, Que., will not open until early 1958, the order for the carpets has already been placed with Canadian mills. To cover the 21 floors, 12 miles of it will be required for the bedrooms, 20 miles for the corridors and another 4 miles for the banquet and convention halls. The total cost will run more than $350,000.

●

In Norway, profits from football pools are being given to scientific research groups. The plan was adopted 9 years ago by an act of parliament and according to the United Nations Educational, Scientific and Cultural Organization, the support last year reached a figure of $3,192,000.

●

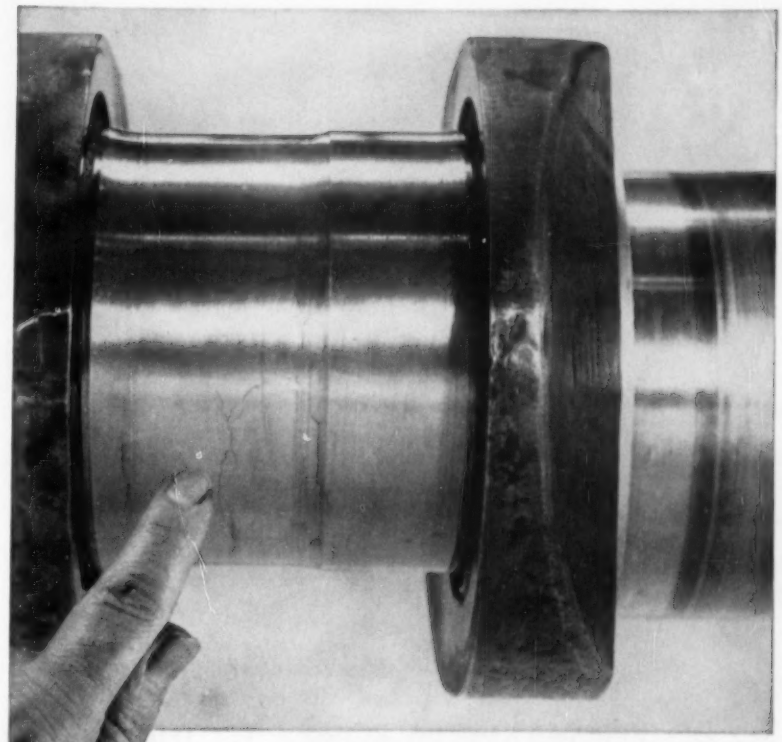
Most of the off-highway trucks that were exhibited at the recent Road Show in Chicago, Ill., have power-operated steering gears, brakes and clutches and are provided with cab-ventilating equipment. One 30-ton unit can't break a spring because the body rides on four big air pistons instead of steel.

●

One third of all Hudson River traffic north of George Washington Bridge at New York City is crushed stone produced by the New York Trap Rock Corporation. Last year the firm moved more than 6¼ million tons of the material by barge.

●

Steel pipe to carry steam at 1200°F and a 5000-psi working pressure has been produced by Sharon Steel Corporation of Sharon, Pa. It is to be placed in Philadelphia Electric Company's Eddystone Power Plant next year.

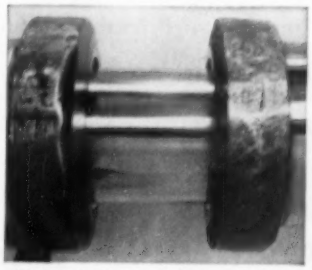


THIS CRANKSHAFT JOB NEEDS A SPECIALIST

This is specialized work, rebuilding crankshafts—intricate, exacting, and naturally expensive. It's the kind of work that demands a specialist . . . and we are just that!

We've specialized in rebuilding crankshafts, because since 1916 we've *made* crankshafts. And who knows better than a maker what are the "musts" of a sound, economical repair job. We'll take your worn crankshaft and rebuild it, if salvagable, through the carefully controlled steps of grit blasting, replating, regrinding and thorough inspection. And we'll deliver it back with a guarantee for 100% performance that only a manufacturer-specialist can provide. May we quote on your next job?

For more details on crankshaft repair write for Bulletin RC-4



This is a finished, repaired crankshaft, after processing by National Forge.

NATIONAL FORGE AND ORDNANCE COMPANY

Irvine (Warren County), Pa.

Circle 27A on reply card

"Standard of Quality"

TO DELIVER MAXIMUM POWER TO THE DRILLS

In rock drilling, pavement breaking and all other heavy-duty air tool operations, you can count on "Subway" (R) for uninterrupted delivery of full-capacity air pressure, and to stay on the job **longer**, regardless of the severity of the service. Despite its extra strength and durability, this "Standard of Quality" hose is light in weight, very flexible, easy to handle.

"Subway" (R) specifications include tough, oil-proof black rubber tube; highest quality wrapped duck carcass; and a red rubber cover that offers long-lasting resistance to the effects of severe abrasive wear and all conditions of weather. Has criss-cross yellow stripe for easy identification.

Made in sizes ½" to 1¼", I.D., in lengths up to 50 feet.

Contact Our Nearest Branch for Details and Prices

If it's GOODALL, it MUST be Good!

Standard of Quality—Since 1870

HOSE · BELTING · FOOTWEAR · CLOTHING
AND OTHER INDUSTRIAL RUBBER PRODUCTS

GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

Branches and Distributors Throughout the United States and in Canada

Circle 28A on reply card

A liquid-cooled brake has been devised by Raybestos-Manhattan, Inc. It uses a copper lined brake shoe and water jacket, connected by a tube with the radiator cooling system. The idea is to remove the heat from the brake as fast as it develops during stopping, thus preventing a loss of braking effect and expansion of the drums. The company reports that under test conditions, the new device was more effective and is expected to have a longer service life than conventional models that are made of asbestos.

●

Less expensive gold finishes are now possible, according to Hanovia Chemical & Manufacturing Company of East Newark, N. J. The firm has developed a heat-treatment method of applying 22-carat gold to large surface areas of stainless steels, ceramics and porcelain enamels. Hanovia claims that an area of 50 to 60 square feet can be covered for about $17, thus making the glittering finish economical for use on architectural structures.

●

Welding is playing important roles in almost all fields from that of atomic energy to the exploration of the universe. To meet the demands of high production, controlled quality and cost reduction, there has been a mechanization of welding processes. According to J. H. Humberstone, president of Air Reduction Sales Company, this rapid growth and development will carry welding industry sales over the billion dollar mark before 1960.

●

To keep the cooling systems of their vehicles from freezing during cold weather, America's motorists and fleet owners bought about 107 million gallons of antifreeze solutions last year—a retail sales value estimated by Chemical Specialties Manufacturers' Association to be approximately $275 million.

●

A machine that rolls metal strips directly from powder has been developed by Stanat Manufacturing Company, Inc. It has been successfully tested for use with aluminum, brass, copper, nickel, nickel-iron, molybdenum, tantalum and stainless steel.

●

Armour Research Foundation has developed a device that transmits high-frequency sound waves to detect disease. A beam of sound is bounced from the deep tissues of the body to a screen where readings can be interpreted to determine the disease and its effect on the body.

●

Now that the baseball season is here, thoughts are turning to the staple food of fans, the hot dog. According to a recent report, more than 7.2 billion frankfurters were consumed in the United States during 1956.

Industrial Books, Films and Literature

Integrally-built diesel-engine compressors for use in industrial and chemical plants, mines and large construction projects are described in Bulletin No. 3207 released by Ingersoll-Rand Company. Each unit combines a 4-cycle V-angle heavy-duty engine with a slow-speed horizontal compressor on a single crankshaft without the use of gears or other coupling mechanisms. Designated as SVO, it is the successor to the XVO type and is available in five sizes with compressor cylinders reportedly capable of handling air or any gas at any commercial pressure or vacuum. *Circle 22E on reply card*

Overworked and Underpowered is the title of a 23-minute, 16-mm sound and color film available from The Educational Committee of the Compressed Air & Gas Institute, 1400 Terminal Tower, Cleveland 13, Ohio. It invites all users of air power to survey and reexamine the air system in their plants. According to the movie, a correction of 5 percent of the faults in an air system can result in a 95-percent savings in production efficiency. It points up common difficulties and sets forth remedies to correct them.

Although written as a textbook, *Engineering Thermodynamics* by C. Osborn Mackey, William N. Barnard and Frank O. Ellenwood, all of Cornell University, clearly and accurately presents the basic principles, including properties and processes, of real gases. Mackey, in this volume, has expanded and brought up to date *Heat Power Engineering, Third Edition*, by the other two authors. Extended treatment is given to friction and heat transfer, ideal gas reactions, refrigeration, air conditioning and similar subjects. Fundamentals are stressed throughout and for this reason the book becomes a reference manual for graduate and professional engineers. It is published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $7.95.

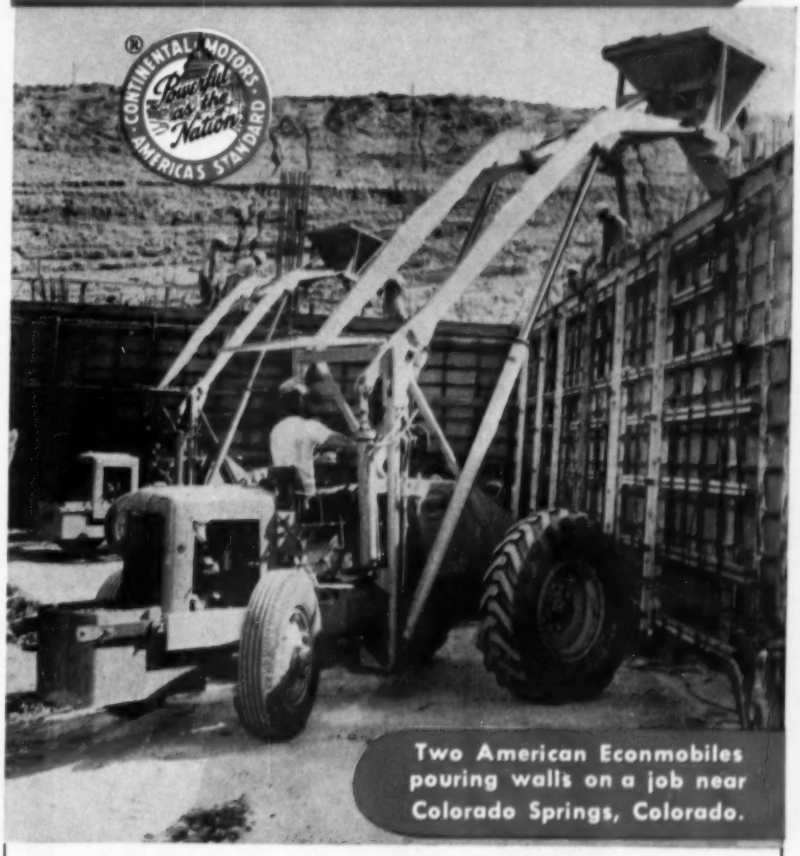
Automatic transfer switches (mechanically or magnetically held) are described in Catalogue No. 57-S1. Catalogue No. 57-S2 covers remote control switches. Magnetically held contactors for normally open and normally closed classes of load are detailed in Catalogue No. 57-S3. 57-S4 describes a complete line of relays and S5, solenoids. Electric plant controls including information on complete systems, paralleling, change over and alternating panels, load demand controls, battery chargers and adapter units are discussed in Catalogue 57-S6. Any of these publications, or Catalogue 57-S that incorporates and indexes the other six, may be had by writing, on company letterhead, to Robert C. May, Director of Sales Promotion, Automatic Switch Company, 50-56 Hanover Road, Florham Park, N. J.

Specification No. S705-1 describes a Brown non-indicating pneumatic pressure transmitter designed by Minneapolis-Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 4, Pa. Using a spiral-spring-and-bellows primary element, it will measure and transmit pressure from 0 to 90 inches of water to 0 to 4000 psi. It can be flush or surface mounted.

The AmForge Division of American Brake Shoe Company has published an illustrated booklet on the applications of steel forgings. Research, engineering and production facilities for drop, press and upset forgings are also covered.

Circle 23E on reply card

Continental-Powered ECONOMOBILE



Two American Econmobiles pouring walls on a job near Colorado Springs, Colorado.

"Cuts Labor Costs in Half"

That's the report from Massa Brothers, Inc., Pennsylvania contracting firm, on completion of a 1½-year project consisting of two schools. "The Econmobile, in spite of rain and mud, was always working, hauling materials from storage site to actual installation, eliminating most of the jobs normally done by helpers, and doing them more economically and efficiently. It paid for itself many times over."

MASSA BROTHERS' EXPERIENCE LENDS ADDED FORCE TO THE SUGGESTION: YOU'RE BETTER OFF WITH EQUIPMENT WITH DEPENDABLE RED SEAL POWER.

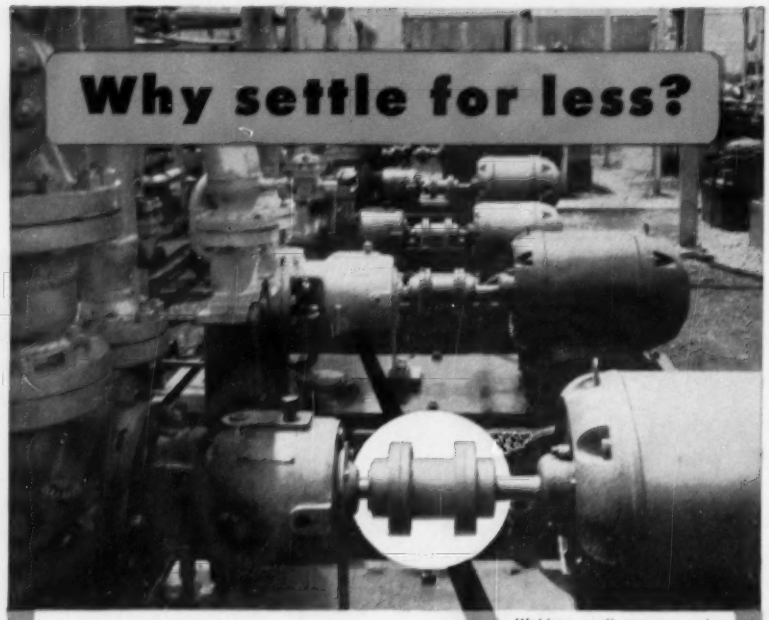
Continental Red Seal engines are available for use on all standard fuels. There's a model engineered to the needs of every construction job.

Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3811 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6210 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 1252 OAKLEIGH DR., EAST POINT (ATLANTA) GA.

Circle 29A on reply card



Waldron couplings on processing pumps in a natural gasoline plant.

by specifying

WALDRON

Gear Couplings

you get

STRENGTH —Hubs and cover sleeves for sizes 1¼A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

RELIABILITY —There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is positioned where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

SERVICE —Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

▸ Ask for Catalog 57

JOHN **WALDRON** CORP.

NEW BRUNSWICK, NEW JERSEY

Representatives In Principal Cities

EXPORT AGENTS - FRAZAR & CO., NEW YORK, N. Y.

Circle 30A on reply card

Automatic package-type controls for most industrial applications involving chemical or mechanical functions that can be measured electrically are described in Catalogue No. AC-2, issued by Tipp-Tronic, Inc. Applications suggested in the bulletin include control of temperature, torque, viscosity, current, voltage, timing of welding, conveyor overload, speed, plating, battery charging, radiation, moisture content, pressure, deflection, thickness, weight, color and light. *Circle 24E on reply card*

Consumers in the United States can take advantage of Watco-Dennis Corporation's line of penetrating oil and resin compounds for protecting concrete, terrazzo and interior and exterior wood surfaces. Formerly these products were only available in foreign countries. According to the company, they do not leave a temporary surface film, but blend with and become an integral part of the area treated. A folder outlining the substance is availble.

Circle 25E on reply card

Contact meter-relays, instruments that both indicate and control almost any physical or chemical condition that can be detected electrically, are described in Catalogue No. 4-C, issued by Assembly Products, Inc. Complete information for ordering meter-relays intended for use in original equipment or in self-contained control packages is given, and various circuits for providing different types of control action are discussed.

Circle 26E on reply card

Tru-Track steel belt conveyors for applications in processing urea formaldehyde, metal automotive parts, metal packing and the like, are discussed in a bulletin issued by Sandvik Steel Belt Conveyor Division of Sandvik Steel, Inc. It explains how V-ropes bonded to the underside of the conveyor belt travel over groved sheaves to maintain proper belt alignment and reduce initial conveyor costs.

Circle 27E on reply card

For the convenience of design, lubrication and production engineers, Stewart-Warner Corporation has produced a catalogue that is a handy guide for easy, rapid selection of the correct fittings for every requirement. Each element in the brochure has detailed dimensions for transfer to particular blueprints. Standard high-pressure fittings as well as accessories are listed.

Circle 28E on reply card

Information on industrial gaskets, mechanical packings, boiler and radio speaker gaskets, packing hooks and steel rule dies is contained in a 48-page catalogue, published by Phopac, Inc. A special engineering section includes a gasket recommendation chart, comparative-cost material graph, gasket fault-elimination table, mechanical formulas and decimal equivalents.

Circle 29E on reply card

As an aid to management in preventive maintenance programs, Tapecoat Company has prepared a folder featuring protective coal-tar coatings in tape form to combat corrosion of pipe, joints, fittings, couplings, tanks, cable, conduit and tie rods in underground service.

Circle 30E on reply card

American Cyanamid Company is offering to companies using chemical processes a bulletin that gives technical data on seven types of aerosol surface agents. Included is material covering data for testing effectiveness, information on storage and handling and a bibliography.

Circle 31E on reply card

PROOF
OF PERFORMANCE...

BEARIUM METAL is superior to any other bearing material. This statement can be substantiated by "proof of performance" reports from scores of satisfied users.

BEARIUM METAL demonstrates its superiority most quickly wherever there is a bearing application involving high speeds, poor lubrication, excessive loads, elevated temperatures, dusty and gritty surroundings —or where a liquid other than oil must be used as a lubricant.

Yes, BEARIUM METAL *does* outperform all other types of bearing materials . . . on *all* counts! Try it on one of your toughest applications and prove it to your own satisfaction.

FEATURES: Non-Seizing and Non-Scoring. Long-Wearing • Self-Lubricating • Low Coefficient of Friction • High Compressive Strength • Resistant to Shock Loads • Sound, Uniform Structure • Free-Cutting.

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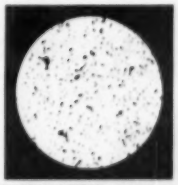
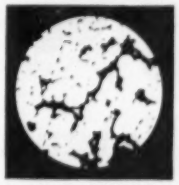
IN CANADA:
Bearium Metals of Canada, Ltd.
155 George St. Toronto 2, Canada

Circle 31A on reply card



BEARIUM METAL *magnified 25 diameters shows lead (black) in microscopic, globular form, uniformly distributed.*



ORDINARY LEADED BRONZE *at 25 diameters shows poor lead distribution, with lead between copper grains.*

Air Traps STRANGLED by OIL?

Get ARMSTRONG Inverted Bucket Air Traps — They Remove Water and Oil — *without clogging*

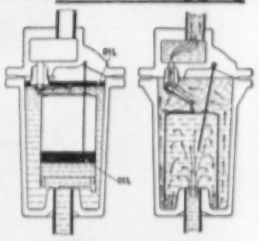
When heavy-duty compressors pump oil, ordinary ball float traps will clog up. With Armstrong inverted bucket traps, oil floats to the top — is discharged ahead of the water.

No trouble with dirt, either. It stays in suspension and is washed out with the water . . . no dead spots for it to collect . . . can't settle on valve or seat—they're at *top* of trap.

Fits anywhere—installs *above* drip point, as well as below.

Other advantages:

- Scrubbing wire keeps bucket air vent from clogging.
- Open bucket float can't collapse.
- All stainless steel mechanism lasts for years.



HOW THEY WORK

CLOSED: Oil collects on top of water in trap. Air in trap floats bucket. Valve held closed by pressure.

OPEN: When water disperses air in bucket, bucket sinks, pulls on lever and opens valve. Oil floats out along with condensate.

Send for Free Bulletin No. 2023
Gives full information, including prices, for selection and installation help.
Call your local Armstrong representative, or write:

ARMSTRONG MACHINE WORKS
8853 Maple Street, Three Rivers, Michigan

Satisfaction Guaranteed

Circle 32A on reply card

GET THE MOST OUT OF YOUR COMPRESSED AIR EQUIPMENT . . . SPECIFY
CONRADER UNLOADER VALVES

New Models . . . Smaller . . . More Compact

Positive operation in any position.

Adjustable differentials.

Operating pressures from 4 p.s.i. to 600 p.s.i.

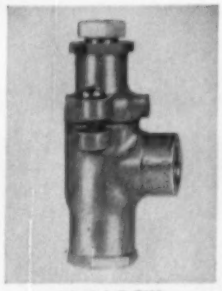
Standard on leading compressors.

Conrader's exchange service trades you a completely rebuilt valve for an old one with new valve guarantee.

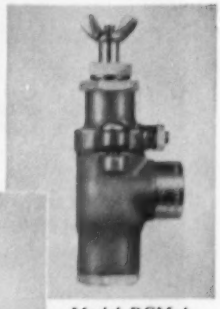
One day service on repairs.

Conrader is equipped to custom design special valves in pressures to 1000 p.s.i.

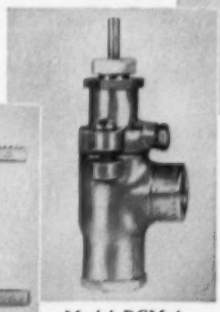
Distributor Franchises Open.



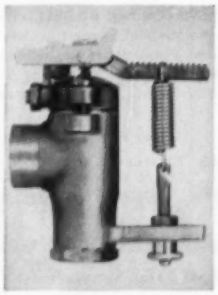
Model RCW



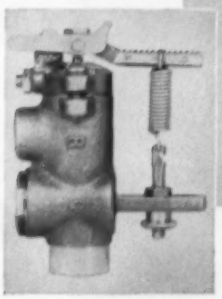
Model RCM-A with hand unloader



Model RCM-A



Model RCF



Model RCS
(Available with drain cock)

R. CONRADER CO. INC.

Box 924 ERIE, PA. Since 1925

Circle 33A on reply card

FOR THE LASTING PROTECTION OF PLASTIC PIPING SYSTEMS....

Specify WALWORTH PVC

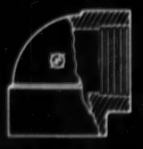
(rigid polyvinyl chloride)

Valves and Fittings!

Walworth plastic valves and fittings are made of non-aging, non-corrosive and non-toxic unplasticized rigid polyvinyl chloride (PVC). These products are highly resistant to chemical attack and offer the advantages of immunity to galvanic corrosion and high impact strength at temperatures as high as 150°F. Durable and light, Walworth PVC valves and fittings are simple to install, easy to maintain (no painting), and add a smooth, clean appearance to your piping system.

Walworth PVC Y-Globe Valves are designed to regulate the flow of alkalies, acids, and similar corrosive fluids. Walworth PVC Diaphragm Valves* are commonly used in systems handling corrosive fluids, especially those containing suspended materials, and can be furnished with diaphragms suited to your application.

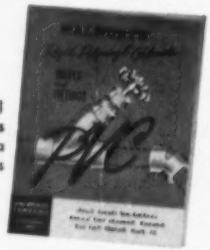
*Hills — McCanna (Saunders Patent)



90° SCREWED ELBOW

90° SOLVENT WELD-SOCKET TYPE ELBOW

A complete line of Walworth screwed and solvent weld socket type fittings are available in sizes from ½" to 4" and include 45° and 90° Ells and Tees . . . flanges . . . plugs . . . bushings . . . straight and reducing couplings . . . screwed and flanged unions . . . caps . . . nipples.



SEND FOR THIS BOOKLET. It describes mechanical and thermal properties, working pressures, sizes and dimensions, application and assembly data for the complete line of Walworth PVC Valves and Fittings. Please use company letterhead.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION GROVE GROVE VALVE & REGULATOR CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. M&H M & H VALVE & FITTINGS CO. WALWORTH COMPANY OF CANADA, LTD.

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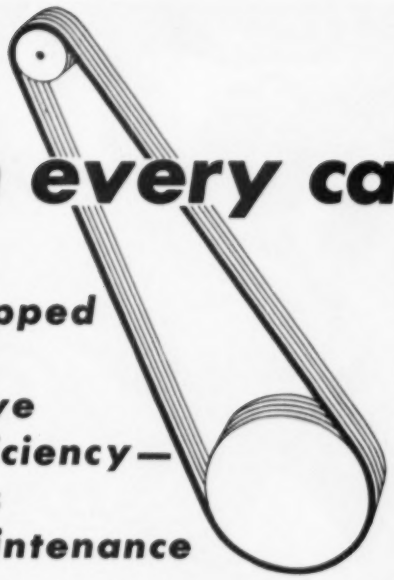

in every case

stepped up drive efficiency— less maintenance

with Wood's complete drives

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T. B. WOODS SONS CO.

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- ☐ Compressed Air Data and Cameron Hydraulic Data..Both books for $5.00
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- ☐ Enclosed is (money order) (check) for $.....) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

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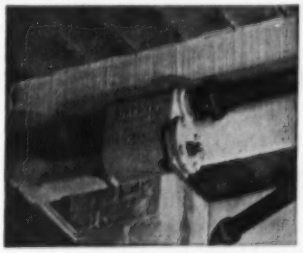
DEPENDABLE PNEUMATIC SERVICE

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

Circle 36A on reply card

Mining Molybdenum in the Colorado Rockies

Bartlett Mountain, on the Continental Divide at Climax, Colo., is the largest source of molybdenum in the world. The 13,863-ft giant is mined by Climax Molybdenum Company. Bethlehem Hollow Drill Steel is used extensively in making the blast holes.

At the Climax mining operation, molybdenum is produced as the primary product, with tungsten, tin and iron pyrite the byproducts. The method used, called cave mining, consists of tunneling through the ore body, then undercutting and caving so that the ore is converted into a mass of broken rock, which is removed much like gravel coming from a hopper.

The blast holes, ranging in depth from 8 ft to 35 ft, are commonly made with Bethlehem Ultra-Alloy Drill Steel in hexagons, quarter-octagons and rounds, fitted with carbide-insert bits.

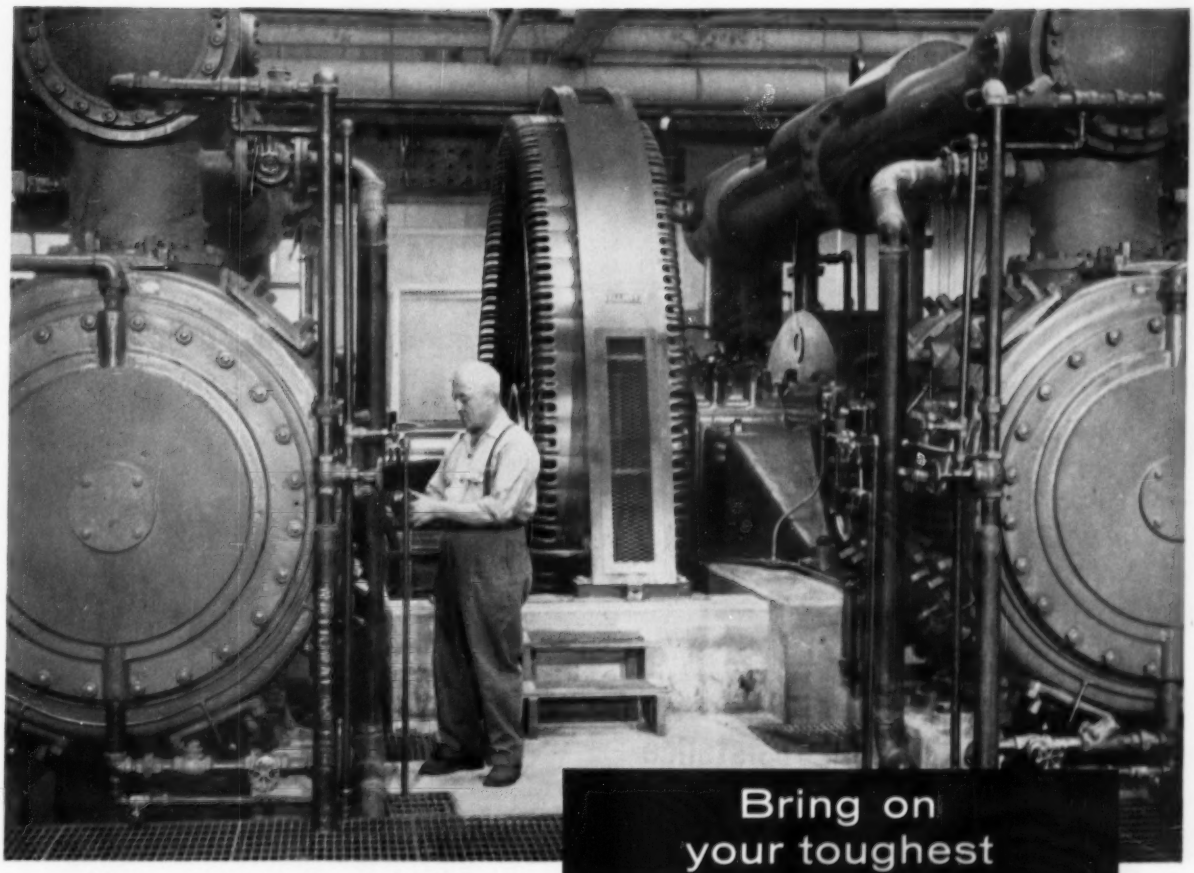
Bethlehem Hollow Drill Steel, whether Ultra-Alloy or Carbon, is just what you need for economical drilling because it is made of fatigue-resistant steel, and has a uniform, centrally located hole. Besides, it has a wide quenching range, and is easy to heat-treat for the proper balance of toughness and wear-resistance. It is regularly furnished in lengths of from 18 ft to 27 ft.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM HOLLOW DRILL STEEL CARBON AND ULTRA-ALLOY

BETHLEHEM STEEL



Compressors here are being driven by a 2000-hp, 164-rpm Elliott Synchronous Motor.

Bring on your toughest compressor drives...

ELLIOTT synchronous motors take 'em in stride

This giant-sized stator for another Elliott Motor is ready to go!

That's what they're built for—the toughest jobs anywhere. And in successful installations all over the country, Elliott motors, like the one above driving compressors in an automobile manufacturing plant, have demonstrated superior performance.

The reason is in the rigid fabricated construction and unequalled insulation protection. In fact, every construction detail has been carefully designed to provide enduring strength—electrical and mechanical—to stand up to shocks, strains, stresses, and vibrations in almost any conceivable type of application. For a complete discussion of the Elliott synchronous motor construction features, ask your nearest Elliott District Office for bulletin PB-5000-2, or write . . .

ELLIOTT Company

Ridgway Division, Ridgway, Pa.

R7-8

PROBLEM:

How to get extra wear resistance high core strength and good toughness in impact mechanism of new power hammer

SOLUTION: Nickel alloy steel—Carburize!

The parts shown in section above are the heart of the impact mechanism of Ingersoll-Rand's new lightweight electric power hammer.

They're made of 8640, a nickel alloy steel. By carburizing the parts, I-R gets a surface with extra wear resistance while retaining the very high strength of the fully hardened core to take the impact and stress of 2300 blows a minute.

Piston, crosshead and both outer and inner spring seats are made this way. They can withstand terrific, continuous pounding and shock load *with a minimum of wear . . . without deforming or cracking.*

Your requirements may be altogether different from Ingersoll-Rand's. But when you need a metal with the "extra" properties there's a grade of nickel alloy steel to cover practically every fabricating or service demand.

Send us details of your application and we'll be happy to help you.

New electric power hammer by Ingersoll-Rand, New York, N. Y., can be used for breaking concrete (above), stone, macadam . . . for drilling, roughing, cleaning, caulking, scaling, chipping, seaming and dozens of other jobs. Unit weighs only 12 lbs. and features an exclusive "spring floating" piston.

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N. Y.

GASOLINE
GREASE
HYDRAULIC FLUIDS
OXYGEN
WATER
WHAT'S *Your* COUPLING APPLICATION?
STEAM
AIR
VACUUM
OIL
ACETYLENE
REFRIGERANTS
COOLANTS

SPECIFICALLY ENGINEERED
. . . NEVER MERELY ADAPTED
. . . FOR EACH PARTICULAR
TYPE OF APPLICATION

HANSEN

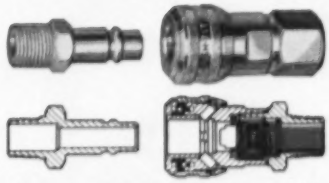
QUICK-CONNECTIVE COUPLINGS

For Pneumatic or Hydraulic Line Service

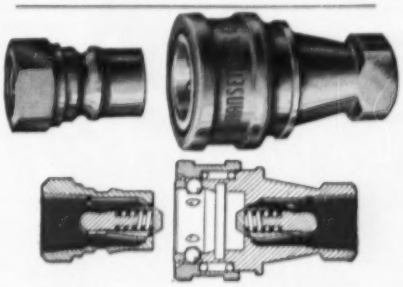
Regardless of whether your particular application requires One-Way Shut-Off, Two-Way Shut-Off, or Straight-Through Couplings—or Couplings for special service on fluid lines carrying oxygen, acetylene, gasoline, steam, etc.—you can always select a Hansen Coupling specifically engineered for your requirements.

As the result of years of experience with fluid line layouts in thousands of plants, each type of Hansen Coupling is carefully designed to incorporate the specific features needed for the job it is intended to do.

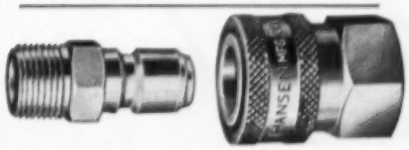
The next time you plan to alter or install a fluid line hook-up, make use of the know-how of your nearest Hansen representative. You'll find him a real help in getting *exactly* the Couplings you need to do the job.



ONE-WAY SHUT-OFF



TWO-WAY SHUT-OFF



STRAIGHT-THROUGH COUPLING

Write for the Hansen Catalog

Here's an always ready reference when you want information on Couplings in a hurry. Lists complete range of sizes and types of Hansen Quick-Connective Couplings. Write for your copy.

Representatives in Principal Cities

SINCE 1915 ®

QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

how to get the most out of HOLLOW DRILL RODS

The present trend in mining is toward smaller drill holes which require the use of smaller bits and, consequently, smaller hollow drill rod sizes. And that's increased the use of *alloy* steels such as Crucible CA DOUBLE DIAMOND and 4E Hollow Drill Rods.

These new alloy rods have proved themselves on many jobs by lengthening rod life, cutting drilling costs. But they are not unmixed blessings, for they will give a good account of themselves only if they are handled properly. Hammer and tongs blacksmithing isn't enough. Alloy rods demand greater care in forging, upsetting and heat-treating.

Should You Use Carbon or Alloy Rods?

There's no one answer to that question, unless it is *use the rod that best fits the individual job.* Generally, air-feed jackhammers and other small, light drills benefit from the use of alloy drill rods. For alloy rods have greater resistance to fatigue, higher elastic limits – important where smaller rod sizes are used.

Rod Stiffness . . .

Rigidity or stiffness can only be increased by enlarging the cross section of the rod. If you decrease the cross section you'll get more whipping no matter what type steel you use, or how you heat treat it. Therefore, don't use a ⅞″ hexagon alloy rod when you've been using a 1¼″ round carbon rod, unless an increase in flexing and less stiffness is unimportant.

Abrasion Resistance . . .

The higher the hardness the better a drill rod will stand abrasive wear. Alloy rods have the advantage in this respect, for they can be heat-treated to higher hardnesses than can carbon rods.

Notch Effect . . .

Notch effects caused by failure to overlap heats in treating shanks, or those caused by careless handling, chain marks or corrosion pits all cause rod failure. Alloy rods are more resistant to these nicks or notches than carbon steels, but when they do occur failure can be more rapid.

The answer to better drilling is simply this: choose the right drill rod, and then give it reasonable and proper care.

And for the *right* carbon or alloy hollow drill rods – in the sizes, shapes, and grades you need – Crucible is the place to go. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

Visit us at Booth 201
American Mining Congress
Metal Mining Show—Oct. 1-4

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Circle 40A on reply card

ONE-TWO PUNCH for Rocky Roadwork

1 GYRO-FLO COMPRESSOR and 2 FM-4 WAGON DRILLS

cut road-building costs three ways

Here's a high-powered rock-drilling combination that can really set the pace for both speed and economy in modern road work. The proved *dependability* and smooth, trouble-free performance of the Gyro-Flo rotary compressor keeps it *on the job*, with virtually no down-time for attention or servicing.

The versatility and easy mobility of the Ingersoll-Rand FM-4 Wagon Drills means fast, easy setups on any type of ground. Their tremendous striking power, positive rotation and exceptional hole-cleaning ability add up to maximum drilling speed, even in the hardest rock.

And, used with long-lasting, fast-drilling Ingersoll-Rand Carset Jackbits, this combination has no equal for sustained high production at lowest overall cost per foot of hole or per mile of highway construction.

Whether you need one, two, or three of these heavy-duty FM-4s, there's a Gyro-Flo compressor of ample capacity for the job—a 315, 600 or 900 cfm. The Gyro-Flo line also includes three other sizes, down to 85 cfm, for operating smaller air tools. Ask your I-R representative for complete information on this cost-cutting Contractors' Combination.

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

CONTRACTORS' COMBINATION

THE BEST AIR EQUIPMENT for BETTER HIGHWAYS

2-503

ON THE RANGE...more ore is mined with BUCYRUS-ERIE ELECTRIC SHOVELS than with any other make

On the Mesabi Range, more ore is mined with Bucyrus-Erie electric shovels than with any other make — and with good reason. Mine operators have learned they can count on Bucyrus-Eries for highest production at reasonable cost. They set the pace for output, economy, and dependability.

Back of this superior performance are many Bucyrus-Erie design and manufacturing extras. The exclusive two-section boom with tubular dipper handle, for instance, reduces front-end weight, speeds dig-swing-dump cycles. Rugged strength, from boom point to treads, contributes to dependability and low maintenance. Smooth Ward Leonard electric control means fast, accurate response — extra torque when it's needed.

Write for more information on the excavators that set the standards on the Range.

140L57

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10-B 4½-cu. yd.
150-B . . 6-cu. yd.
190-B . . 8-cu. yd.
BUCYRUS ERIE

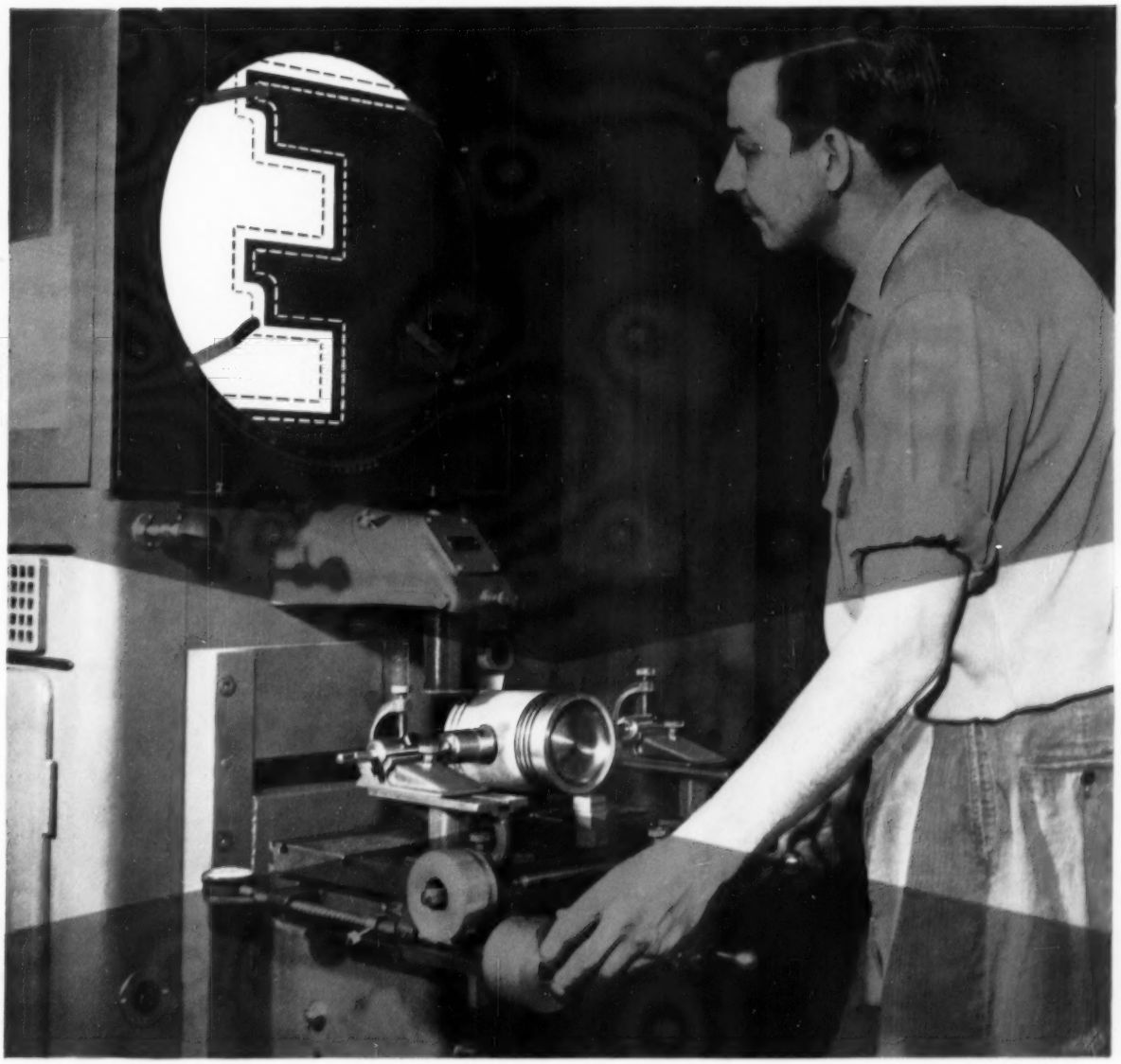
BUCYRUS-ERIE COMPANY

SOUTH MILWAUKEE, WISCONSIN

Circle 42A on reply card

GM DETROIT DIESEL PARTS

—factory-engineered for long life, low-cost service



SHADOWGRAPH CHECKING is one of the precision tests that assure highest quality of factory-engineered GM Detroit Diesel original and replacement parts. In this photo, a magnified piston ring groove is compared with a perfect standard graph. This precision control is important to piston lubrication.

Scientific packaging of GM Detroit Diesel parts assures protection both in shipment and storage.

You're always money ahead when you buy factory-engineered GM Detroit Diesel parts from your Distributor or Dealer

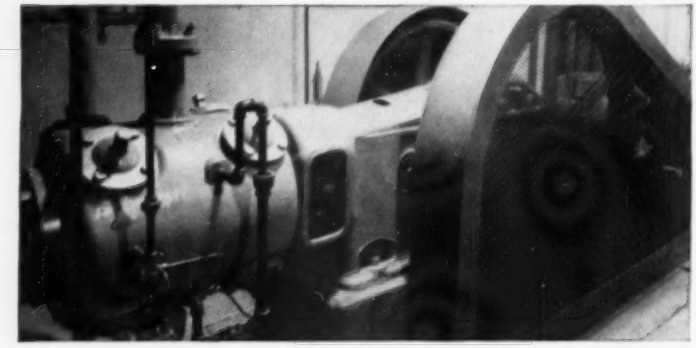
DETROIT DIESEL

Engine Division of General Motors • Detroit 28, Michigan

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

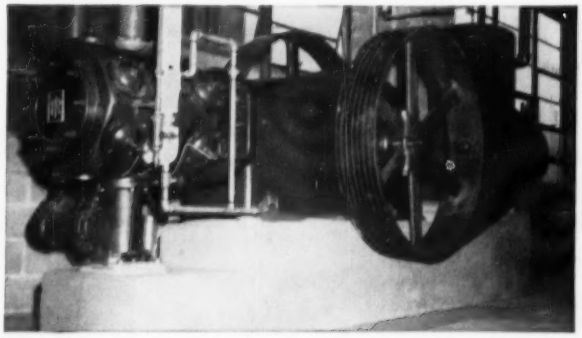
Circle 43A on reply card

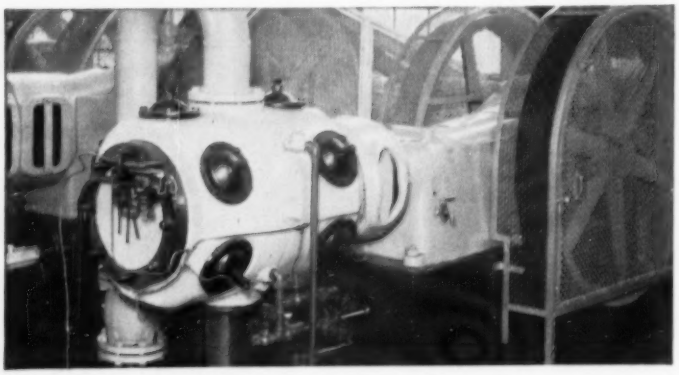
Industry after industry gets less wear, steady air with compressor crankshafts on TIMKEN® bearings



AIR SUPPLY IN OIL RESEARCH LAB IS STEADY with Timken® tapered roller bearings on the crankshaft of this Ingersoll-Rand ES-1 compressor. With Timken bearings, shafts are kept concentric with housings. Closures are more effective. Lubricant stays in—dirt and moisture stay out. It's an example of how Timken bearings cut maintenance costs, keep compressors operating smoothly.

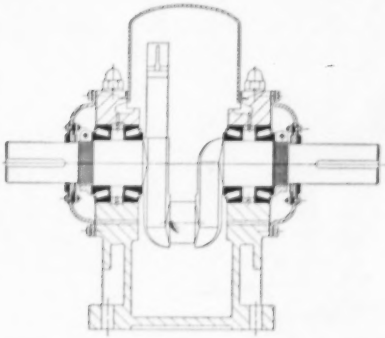
COMPRESSOR SPEEDS CHEMICAL DRYING with Timken tapered roller bearings to keep it on the go. This Ingersoll-Rand ES-1 compressor blows air through a filtered chemical product to remove moisture. Timken bearings on the crankshaft help it do a dependable job with a minimum of wear. Because of their tapered construction, Timken bearings take both radial and thrust loads in any combination. And full line contact between Timken bearing rollers and races gives them extra load-carrying capacity. With the crankshaft held in positive alignment, wear is held to a minimum, downtime and repair costs are cut.





BREWERY KEEPS PRODUCTION UP TO PAR because Timken bearings help reduce compressor power loss. With the crankshaft of this Ingersoll-Rand class ES compressor mounted on Timken bearings, friction is practically eliminated. That's because Timken bearings are designed by geometrical law to have true rolling motion, and they're manufactured with great accuracy to live up to their design.

HERE'S A TYPICAL INGERSOLL-RAND MOUNTING of compressor crankshafts on Timken tapered roller bearings to assure long bearing life with minimum maintenance.



TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

TRADE-MARK REG. U. S. PAT. OFF.

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